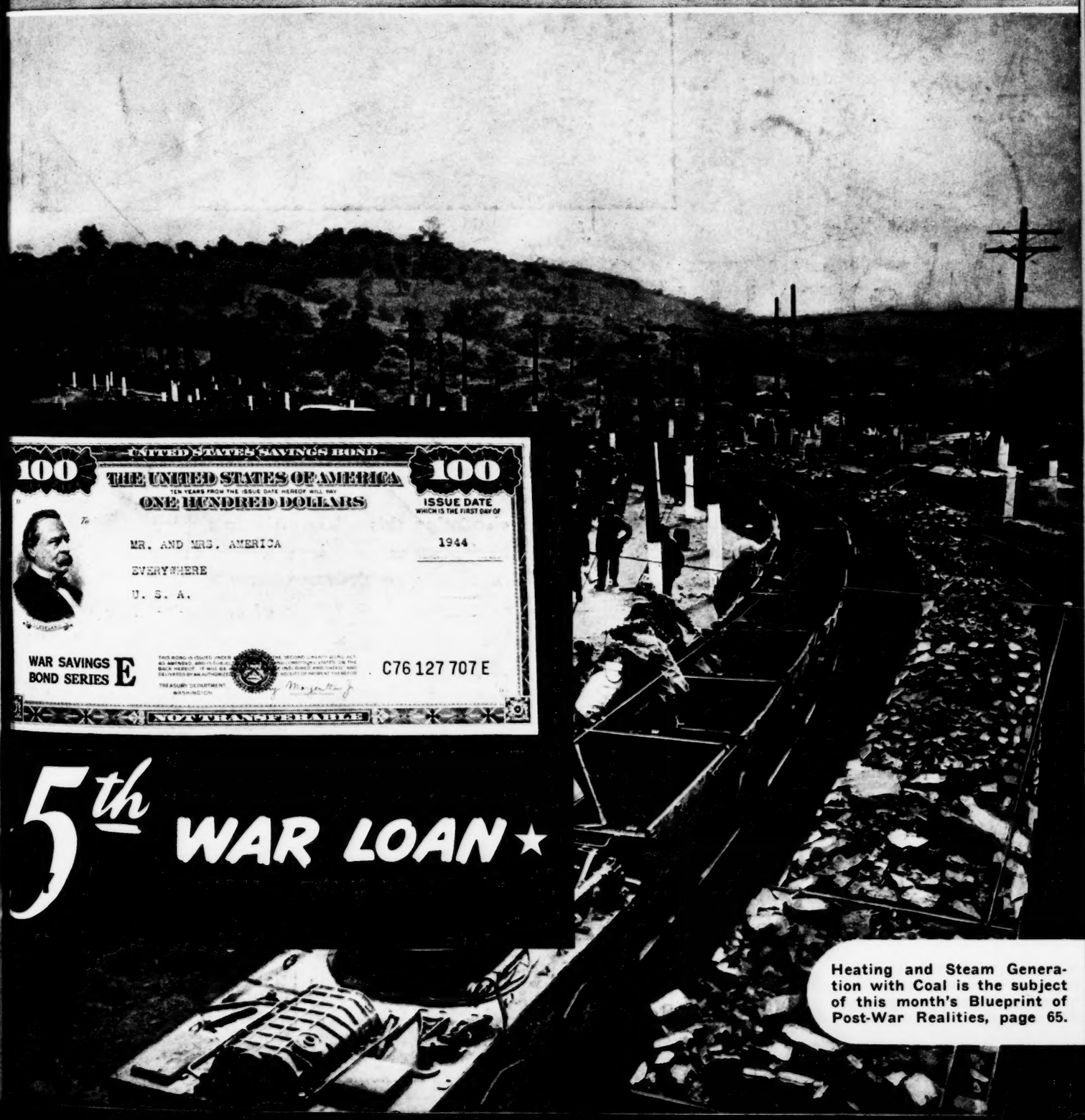
1944

HEATING AND VENTILATING

COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION



Heating and Steam Generation with Coal is the subject of this month's Blueprint of Post-War Realities, page 65.

MODUFLOW CONTROL

THE MINNEAPOLIS-HONEYWELL MODUFLOW CONTROL SYSTEM is the logical step in the evolution of home heating systems.

Instead of alternate periods of heat and no heat, due to intermittent heating and causing drafts and air stratification, which results in cold floors, the Moduflow System of control delivers a constant supply of heat, modulated to the exact degree necessary to offset loss of heat from the home. Moduflow accomplishes this by automatically adding heat from the furnace or boiler with return air or water to exactly the temperature required, and continuously circulating this mixture through the heating system. In the case of steam heat, only enough steam to satisfy the heating requirements is circulated.

MODUFLOW

The Moduflow System of control will be available after the war for any automatic heating plant. Its cost for existing homes is surprisingly low. In new homes it is even less. It is easy to see why the Moduflow System will revolutionize postwar home heating . . . Write for full information to Minneapolis-Honeywell Regulator Company, 2715 Fourth Avenue South, Minneapolis 8, Minnesota. Branches and distributing offices in 49 principal cities.

MINNEAPOLIS

Honeywell

CONTROL SYSTEMS

A MONTHLY
MAGAZINE FOR ENGINEERS
AND CONTRACTORS CONCERNED WITH
COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, PIPING, HEATING, VENTILATION

HEATING VENTILATING

Publisher

THE INDUSTRIAL PRESS

President
ROBERT B. LUCHARS

Vice-President and Treasurer
EDGAR A. BECKER

Secretary
ERIK OBERG

Editorial Staff

Editor
CLIFFORD STROCK

Associate Editor
N. N. WOLPERT

Publishing Information

HEATING AND VENTILATING is published monthly by The Industrial Press at 148 Lafayette Street, New York 13, N. Y. Yearly subscription in the United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies 30 cents. Entered as second class matter, April 18, 1925, at the Post Office, New York, N. Y., under the act of March 3, 1879.

Advertising Representatives

Eastern Representatives
DWIGHT COOK
HARRY J. TWINE
148 Lafayette Street
New York 13, N. Y.

Western Representative
GEORGE G. TURNER
228 North La Salle Street
Chicago 1, Ill.

CONTENTS FOR JUNE, 1944

VOLUME 41 NUMBER 6

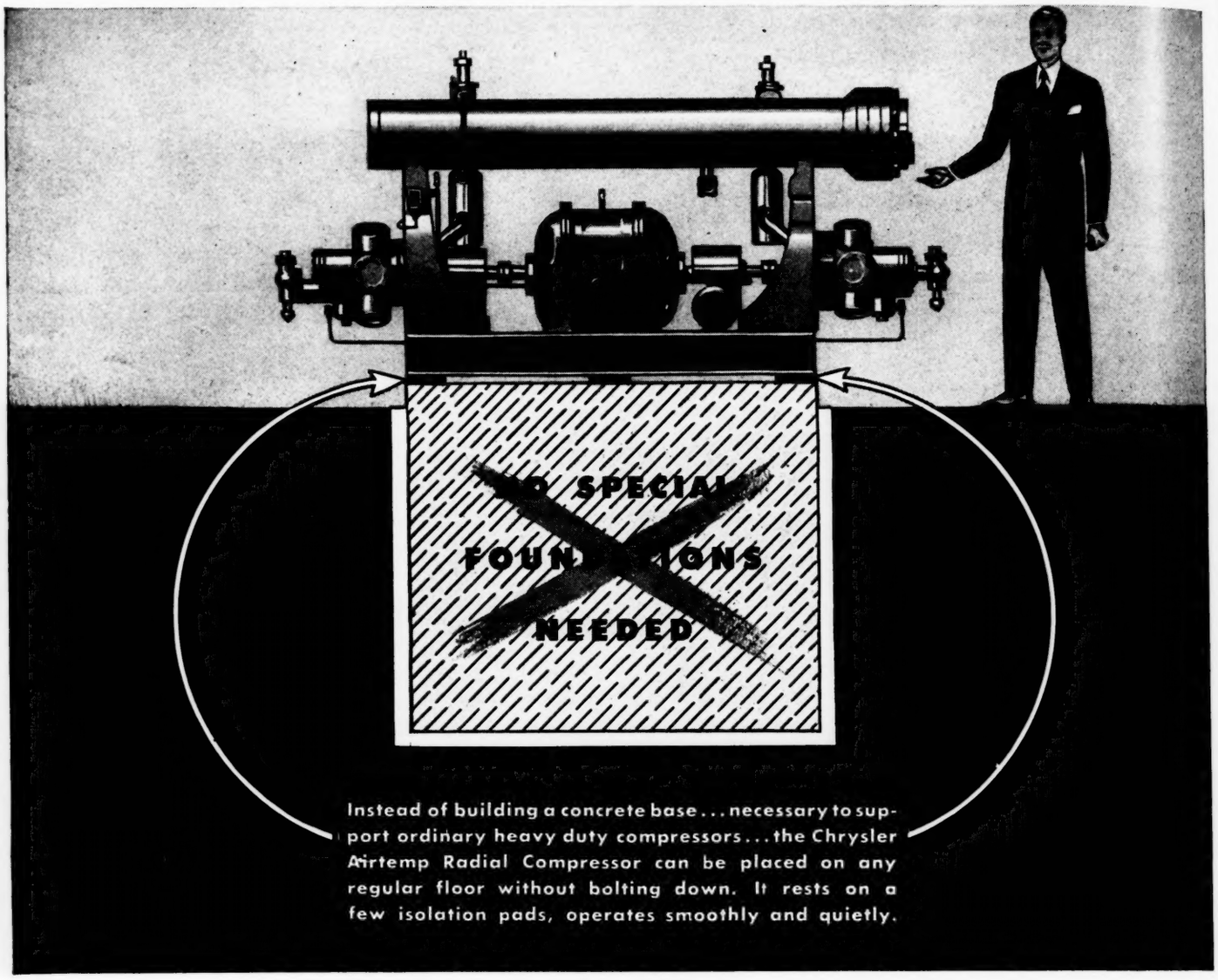
Dust Collecting System in Gunstock Plant 51
Benjamin S. Malin
Grinding Wheel Quality Improved by Controlled Air 55
I. C. Baker
Dust as an Industrial Health Hazard 57
F. W. Hutchinson
Ventilation for Welding Booths 62
M. E. Ringquist
Ventilation for Radium Dial Storage 64
Off Again, On Again 64
John J. Woolfenden
Blueprint of Post-War Realities—Coal for Heating and Steam Generation 65
Irwin R. Hoffman
Some Notes on Radiant Heating 81
T. W. Reynolds
Weather Observers Have Difficulties 81
Central Plant Heats 45 Buildings 82
F. N. Hollingsworth
Building Brazil 84
Washington News 86
Loring F. Overman
News of the Month 88
Brief Reviews 90
News of Equipment and Materials 92
Degree-Days for April, 1944 100
With the Manufacturers 104
Reference Data 271-272 104
Personals and Personnel 107
Getting Personal 110
Army-Navy "E" Awards 110
New Catalogs 111
Industrial Degree-Days for April, 1944 113
Coming Events 113

Copyright, 1944, by The Industrial Press

MEMBER
Audit Bureau of Circulation
Associated Business Papers

NEXT MONTH'S ISSUE

Process piping is a subject that reaches out into many industries. Starting with our July issue Harry D. Unwin, of Albert Kahn Associated Architects & Engineers, Inc., will present the first of a series of articles on design and layout of process piping installations.



Instead of building a concrete base . . . necessary to support ordinary heavy duty compressors . . . the Chrysler Airtemp Radial Compressor can be placed on any regular floor without bolting down. It rests on a few isolation pads, operates smoothly and quietly.

CHRYSLER AIRTEMP

VARIABLE CAPACITY RADIAL COMPRESSOR

Easily and quickly installed

Wherever you find the famous Chrysler Airtemp Radial Compressor . . . you'll find the ease of installation was a pleasant surprise to the owners.

Beautifully balanced, light in weight and practically free from vibration . . . you can balance a penny on it at 1750 R.P.M. . . . the Chrysler Airtemp Radial Compressor, regardless of size, needs no special foundations.

This feature saves unnecessary construction costs—permits location of compressor on an upper floor, the roof or wherever it is most advantageous. Eight years ago, a big radio station even placed a 14 cylinder Chrysler Airtemp Compressor unit right over the sound-proof studios. It's still there . . . doing a superb job.

These days . . . with scarce manpower and a need for time-saving, efficient operations . . . industries and services geared to the war program are turning to Chrysler Airtemp air conditioning and refrigeration units.

If you have a temperature-humidity control problem —put it up to Chrysler Airtemp. You'll find it pays!

BUY WAR BONDS

CHRYSLER AIRTEMP

AIRTEMP DIVISION OF CHRYSLER CORPORATION • DAYTON, OHIO

Tune in Major Bowes every Thursday, CBS., 9 p. m., E. W. T.

HEATING AND VENTILATING

Fig. 1. Outside elements of a dust collecting system. Photograph shows hoppers and chutes.

Dust Collecting System in Gunstock Plant

BENJAMIN S. MALIN

**Captain, Ordnance Department, U. S. Army;
Assistant to the Works Manager, Springfield Armory,
Springfield, Mass.**

ONE of the largest installations of wood dust collecting equipment in recent years in the East is the system in operation at the Gunstock Plant of the Springfield Armory, Springfield, Mass., the oldest arsenal in the country. The site upon which it stands was chosen by General George Washington; a National Armory was established in 1794. This armory has been famous ever since for its attainments in military small arms. Its proudest product is its most recent one, the M-1 Garand semi-automatic rifle. Wood parts for this weapon are manufactured in a new building where the dust collecting system described is located. This unit is one of the recent additions to a large group of permanent industrial buildings.

Black walnut stock blanks, dried to a moisture content of 6 to 8% are shaped, turned and grooved in a series of operations which remove more than 65% of the original material. Some machines in the plant have tools which revolve at speeds from 7,000 to 21,000 rpm. On certain operations, tolerances are held to as low as several thousandths of an inch. The cutters produce slivers, shavings, and dust particles of all sizes. This material is removed and collected very effectively by the exhaust and collecting facilities.

The collecting system consists of 5 distinct exhaust mains to which branches are connected from about 180 production machines. Each machine has one or more efficient hoods especially designed for the particular cut or operation. Machines are set up on a floor 280 feet long by 120 feet wide and many are served by overhead mechanical conveyors. Each main pipe is connected to a separate industrial exhauster of the slow speed planing mill type. The exhausters are V-belt driven by synchronous electric motors with a total rating of 325 hp.

The 5 units have an air handling capacity exceeding 125,000 cfm at the system resistance. The units are installed in the basement below the shop and discharge through vertical pipes to 3 cyclone separators mounted on the shop roof. Exhausters which operate in circuits which are essentially parallel, have common elements. Figs. 1, 2, and 3 show the general arrangement and relative position of the equipment.

Air streams leaving the cyclones enter two cloth screen dust collectors which act as second stage cleaners to remove the finer dust particles. After passing through these filters, the air is returned to the manufacturing space and the basement for reuse.

Air circuits provide 100,000 cfm for the shop and 25,000 for the basement.

Cyclone separators No. 1 and No. 2 handling 30,000 and 40,000 cfm respectively, are 14½ ft in diameter. Cyclone No. 3 is 16½ ft in diameter and handles a 55,000 cfm discharge from exhausters C-2 and C-3. Each cyclone is provided with a wood waste storage box of 1,000 cubic feet capacity, mounted directly below the cone.

Tests show that approximately 92% of the col-

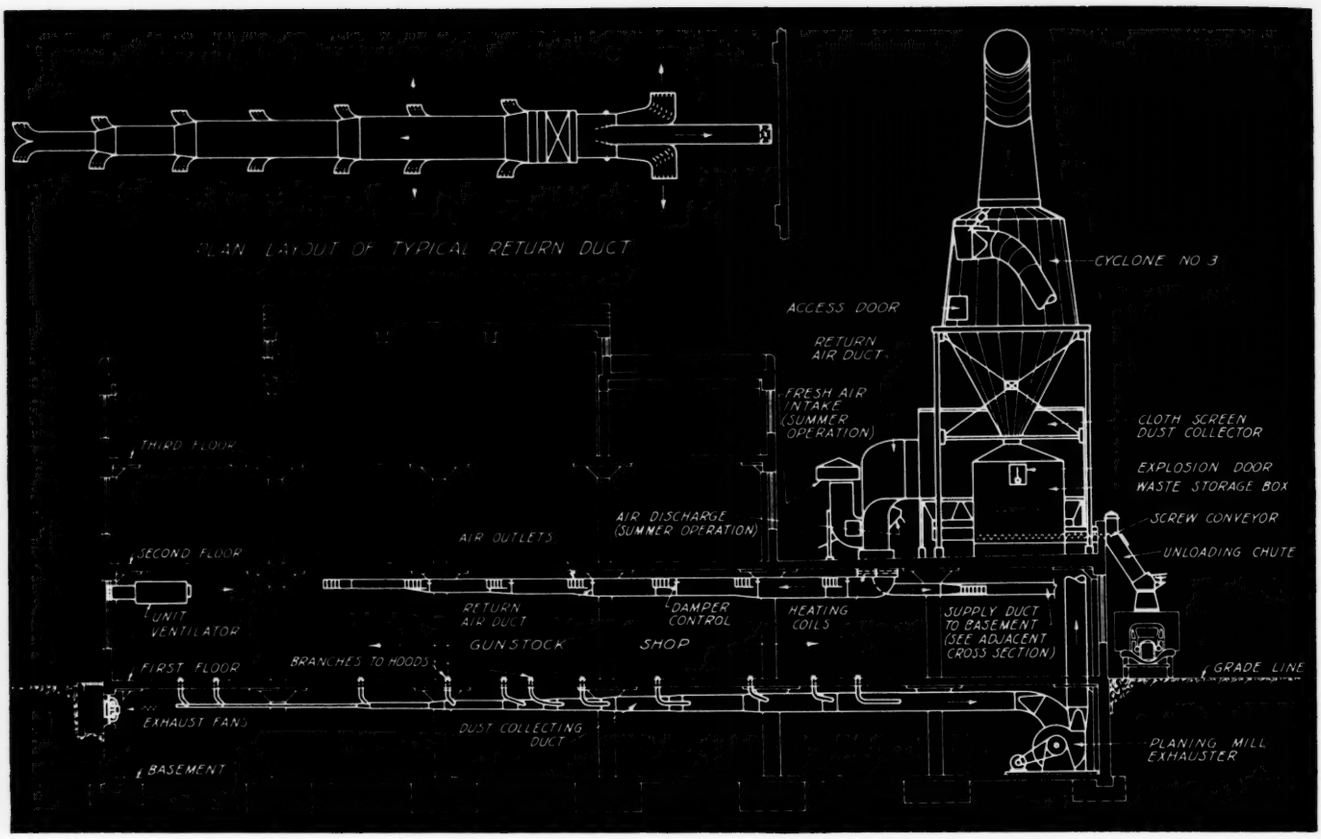


Fig. 2. Cross section showing the arrangement of collecting equipment on roof and relative position of exhaust piping and return ducts; also return duct detail.

lected material is deposited in these boxes. The remaining 8%, in the form of very fine dust, escapes through the cyclone outlets and is entrained on the dust collector screens. During the rapping periods it falls into the hoppers below.

The entire wood waste generated amounts to nearly 25 tons per day under a 24-hour full load production schedule. This material may be unloaded from the filter hoppers and dust storage boxes at any time, whether or not the dust collecting system is in operation. Dampers, chutes and connections are made dust tight, and substantially air tight, so that no dust clouds can escape even though internal pressures within the collecting system run as high as 4½ in. w.g. static pressure.

Multiple spiral screw conveyors carry the dust out to special trucks on the roadway outside of the building. The conveyors can be started and stopped at will by truck operators and each load can be inspected from time to time by opening hatches on the top of the truck body.

Exhausters operate under an average system differential of 8.9 in. w.g. static pressure which includes the resistance of the heating coils and return ducts. Cyclone pressure drops vary from 1.2 to 1.5 in., and that of the filter media 1.3 in. The dust collector entrance and exit losses are unusually low due to the excellent entrance and discharge fittings. With the double back-to-back arrangement used, no entrance baffle is needed. Air enters the top of the collector, between the banks of filters at low velocities (1500 fpm), and loses most of its momentum in the dust side chamber above the hoppers. On the outlet side, two large exit ducts allow the clean air to escape at velocities not exceeding 2,200 fpm.

A suction pressure of about 2¼ in. w.g. is maintained in the various branches near connections to their hoods. Filter screens are rapped automatically every 4 hours, at shift changes and during lunch periods, in order to keep the system resistance and hood suction as nearly constant as possible.

In the early design stages, the need for a secondary cleaner to collect the finer particles of dust was definitely established. Experience on a pre-war dust collecting system at the armory showed that large quantities of fine dust discharged directly to the atmosphere would not be tolerated by the city or by the people living in the residential areas surrounding the armory. Moreover, even if this dust-laden air could be discharged to the atmosphere it would carry with it the heat that was required to bring it from low outside temperatures in winter to room temperature of about 70F.

It then became apparent that a large winter heating load could be avoided by using filters to completely clean the air, and then returning the air to the building for re-use.

Calculations of the heating load which would have to be met, if the air were thrown out, were made. They indicated a capacity of nearly 10,000,000 Btu

per hour to raise the temperature of 125,000 cfm of outside air from 0F to 70F. This is conservative, since Springfield outdoor winter temperatures occasionally reach —15F to —20F. This heating load is roughly the equivalent of 10,000 pounds of low pressure steam per hour and its generation would require a boiler plant of about 300 hp rating.

With the present system, requirements for heating are only 1/5 of this amount as only 25,000 cfm or 1/5 of the total air circulated is fresh air. All of the exhaust air is returned, 4/5 to the shop, the remainder to the basement below.

Savings in operating costs which have accrued as a result of the re-use of this air, are estimated to be at least $6,000 per year in direct heating cost alone. The investment in the boiler plant, auxiliaries and building thereby avoided, represents a considerable saving in overall plant cost.

The 25,000 cfm of fresh air is brought in by 6 heating and ventilating units of the horizontal suspended type. The air temperature leaving is regulated thermostatically and is not allowed to fall below 70F in cold weather. These units introduce fresh air whenever the dust collecting system is running. When the exhaust system is shut off, they simply recirculate room air, and thereby provide heat for the space.

The manufacturing space has a total volume of 435,000 cubic feet. Fresh air changes occur every 18 minutes, an equivalent of more than 3 changes per hour. Total air changes occur every 3½ minutes or more than 17 times per hour.

Despite this high rate of air flow, there are no drafts or cold spots within the utilized space, either in summer or winter. This desirable condition is attributed to the efficient manner in which the return and fresh air are introduced to the room. Return air enters through 32 openings and fresh air through 6. Entrance air velocities are held below 1,400 fpm at openings 10 to 12 ft above the floor. Quick diffusion is obtained by directional vanes in each outlet.

Each of the two dust collectors discharges through a return duct, the design of which is shown in Fig. 1. One branch from each return duct is carried to the basement below, to discharge 25,000 cfm through two plenum chambers each having three propeller fan boosters. This amount is the equivalent of the fresh air introduced into the shop above. Other propeller fans on the opposite side of the basement exhaust this ventilation air. The system, thereby, provides heated ventilation air for the basement with no additional heating cost.

Selection of the return air heating coils was made without definite knowledge of the probable temperature drop of the air in passing through the external piping and dust collecting equipment mounted outside of the building. Calculations, taking into account the many variable factors involved, indicated a loss of about 20F in zero weather. Actual test data taken during the past two winters show the following:

At outdoor temperatures of plus	30F	0F	—15F
Temperature drop of air is	4F	8F	10F

Heating coils are of the extended surface non-freeze steam distributing tube type, selected for use with steam at 5 lb pressure. Operation is controlled by duct insertion thermostats actuating modulating steam valves.

No other means of heating, other than the unit ventilators mentioned, are needed in the shop area. The basement is provided with unit heaters which are used only when the exhaust and return air system is not operating. Internal heat generation in the shop is considerable due to the many electric motors, the extensive lighting, and the shop personnel. During hot weather this internal heat is

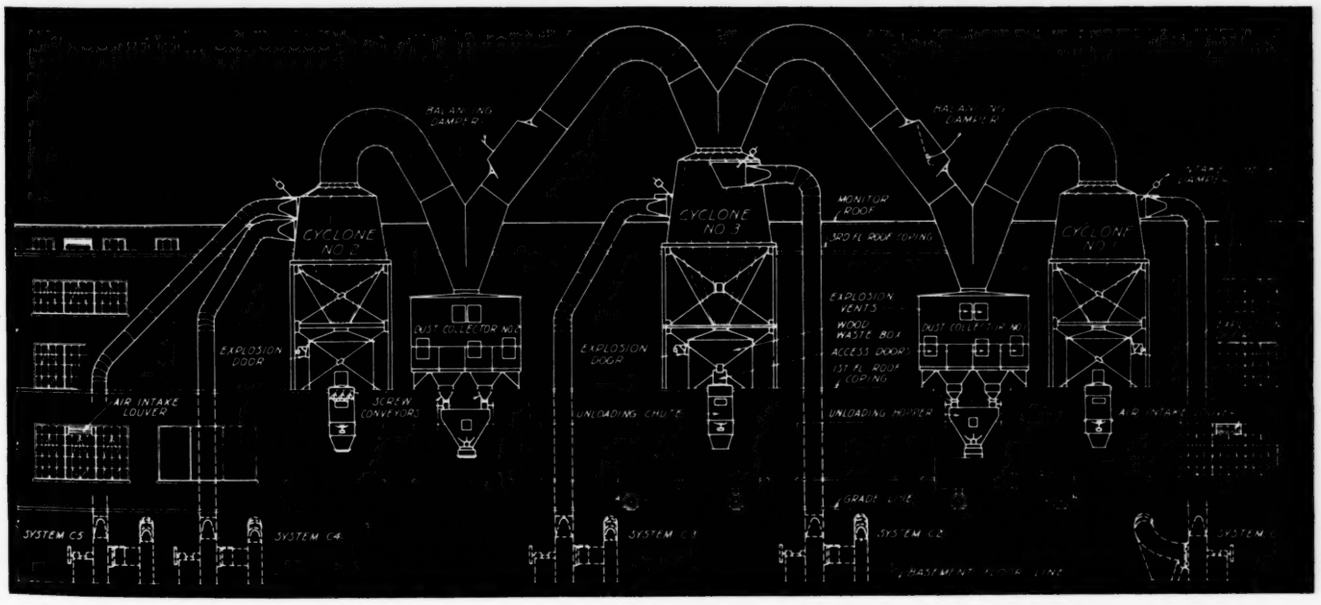


Fig. 3. Elevation showing the external piping, dust collecting equipment, and unloading stations.

partly released by discharging all of the exhaust air to the atmosphere through an opening in the return ducts near the dust collector.

A system of multiple interlocking dampers at that point allows outside air to enter the return system and to flow into the room through the same outlets

Fig. 4. Remarkably clear atmosphere exists in the room where the sanding section is located.

normally handling return air. This flow is induced by slight negative pressure within the building. Exhausters handle the total circuit load in all seasons.

Safety Precautions

To guard against production interruptions due to function failure, or to damage from fire or explosion, many safety code recommendations were followed applicable to this type system. The many safety features include:

1. A dual set of bi-metallic thermostats located in strategic positions in the dust collecting equipment. They are actuated at 135F. When temperatures increase above this point, one set immediately opens the control circuits to all motors and stops air circulation, thus preventing diffusion of heat and burning embers. The other set is connected to an annunciator where each thermostat may actuate an individual tag drop to indicate the location of a "hot spot."

2. A system of fire control incorporating deluge type sprinkler heads is installed in the collecting equipment. These heads operate individually and are located to provide complete coverage. Heads fuse at 165F.

3. Actuation of thermostats and sprinklers is also accompanied by a bell and red light alarm in the shop, and outside the building.

4. The entire system may be quickly stopped in an emergency by means of large red push buttons located in the main shop area.

5. Traps are provided at the inlet of each exhauster for the removal of metallic particles, extra large pieces of wood, and all extraneous material which might find its way into the suction pipe. Traps are designed to utilize momentum and centrifugal force in throwing these pieces out of the air stream, thereby preventing possible damage to the fan wheel blades, screw conveyors, and other apparatus.

6. Dust explosions can be relieved by means of weighted hinged doors and breakable panels located at points where there are dust accumulations.

7. Fire dampers and doors, suitably weighted and retained by fusible links, are provided at points in the dust collectors and in the duct work where the spread of fire from floor to floor may be stopped by closing air passages. All dampers and doors have hinges with bronze or brass pins to prevent "freezing" from rust formation.

8. All equipment and piping are electrically grounded so that static electricity cannot accumulate and cause sparks.

9. Filter cloths are impregnated with a fire-proofing solution. Though this treatment would offer little resistance if the wood powder on the cloth should burn, it nevertheless provides protection during the period of construction, testing and balancing. Tramp metallic particles moving in the pipe at such times might cause sparks which could ignite unprotected cloth.

Other features of the installation are variable pitch multiple V-belt pulleys for the fan drives. These units afford a regulation in fan speed of approximately 18% thereby providing means for accurately setting the fan performance and balancing the systems.

Inspections Made Regularly

In the preparation of designs and specifications, considerable attention was given to details to facilitate the periodic inspection, testing and balancing necessary to keep the systems operating properly. All traps, storage boxes, and piping are provided with air tight and dust tight access doors. Static pressure fittings and tubing, to which "U" gauges may be attached, are provided in the piping and equipment at critical points.

The system described and illustrated represents not the original design but the evolved one. It includes additions made after the original smaller system was installed. The present capacity is considerably greater than formerly. Under existing conditions, the entire combination operates very steadily and provides efficient dust collection and removal 24 hours per day. The shop area is remarkably clean and clear of dust. The plant as a whole is believed to represent the latest in mass production of precision manufactured wood parts.

Conditioned air is distributed in this plastic storage room through uniform slots in the continuous transition duct shown at the ceiling.

Grinding Wheel Quality Improved by Controlled Air

I. C. BAKER
Airtemp Division, Chrysler Corporation, Dayton, Ohio

ACCURATE control of temperature and humidity in the room where plastic binding materials, used in the manufacture of grinding wheels, are mixed and stored has proved to be an important factor in the war production of a mid-west grinding wheel manufacturer.

Plastic materials used in the manufacture of grinding wheels are hygroscopic in nature and vary greatly in their strength and consistency when subjected to conditions of moisture and temperature. As a result, grinding wheels produced at one time become too hard, and in other cases the wheels are too soft. Under both of these circumstances the finished product will not pass inspection and must be scrapped. Because grinding wheels are widely used in the manufacture and finishing of many metal products, they are a production necessity.

Plastics used in the manufacture of these wheels are sensitive to changes in air conditions. Unless moisture and temperature of air are controlled, finished products will not pass inspection tests.

A new building was planned by the grinding wheel company, to be constructed immediately, which would contain a room where plastic binding materials would be stored and mixed under ideal atmospheric conditions.

This room would require cooling, dehumidifying, heating, and humidifying equipment of the most modern type, to maintain design conditions of 70F dry bulb, and 45% relative humidity, throughout the year, winter and summer.

From this point on W. K. Jamison, engineer, Bard, Inc., installers of the equipment, worked closely with the plant executives and engineers, designing a complete temperature and humid-

ity control system which would be entirely satisfactory for the protection of hygroscopic materials kept in storage.

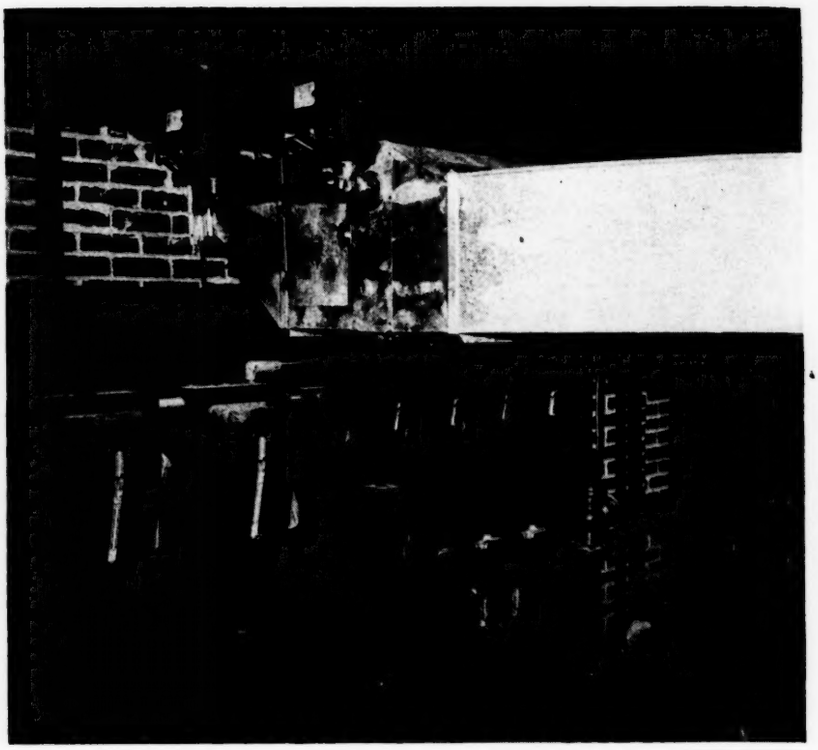
After the material storage room was designed, a Chrysler Airtemp Model 3H 15 hp radial compressor was selected to carry the cooling and dehumidification load. This machine is connected to a Marlo EC-15 air handling unit equipped with a cooling coil of adequate capacity and a four-circuit spray which can be shut off one circuit at a time. Tests on this air handling unit revealed that capacity is reduced as the wetted surface factor is reduced by turning off sprays one at a time. Spraying water over the coils chills the water, thus creating a "flywheel" effect which increases the total capacity of the unit during summer peak periods of operation.

During winter the same sprays may be used to humidify the air entering the storage room.

Steam coils installed in the unit are used for heating in winter, but the unit is also equipped with three 2.5 kw electric strip heaters which may be used for re-heat during periods when the central steam system is not in operation.

A Marlo evaporative condenser is included. This unit conserves about 95% of the water which would ordinarily be used in cooling a system of this size and type. The evaporative condenser, which is installed adjacent to the air handling unit, exhausts heated air to the outside through a duct constructed for this purpose.

A single duct having a constant transition from one end to the other, distributes air in the storage room. This duct has a slot along one edge which is the same depth for the entire length. The amount of air reaching the room at any given point is governed by the width of the duct.



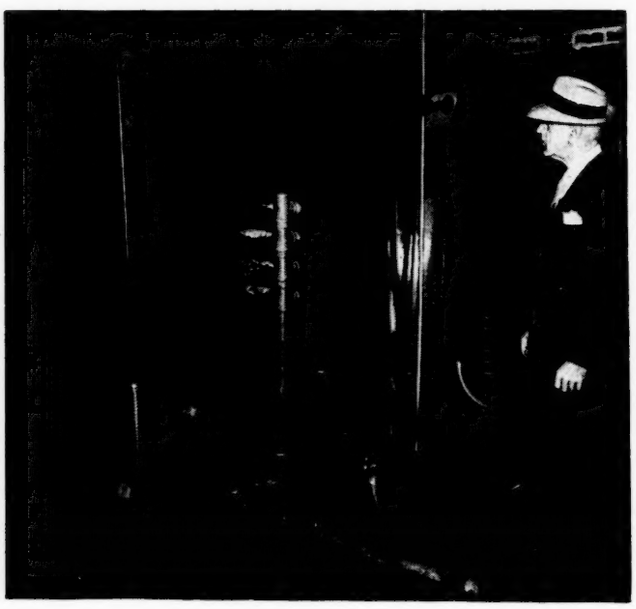
Two damper motors, shown at the top, control the air entering the plastic room. All controls are Minneapolis-Honeywell.

Controls used throughout the system are Minneapolis-Honeywell. For summer operation a thermostat located within the conditioned space is set to maintain 70F by control of the compressor and electric strip heaters in the air handling unit. The wet bulb controller in the space is set to maintain 45% relative humidity, and actuates the compressor.

During summer operation, the compressor functions if cooling is required. If cooling is satisfied, and dehumidification is needed, the compressor continues to operate and electric strip heaters come on, re-heating the air. Strip heaters are controlled in three steps, each furnishing 3,100 watts of heat. Heaters are necessary as no steam supply is maintained in the plant during warm weather.

For winter operation, the thermostat operates the compressor or the modulating steam valve on heating coils. The dew point controller operates compressor or steam humidifier within the space, maintaining the correct relative humidity at all times.

The amount of outside air and return air handled is controlled by a modulating damper motor operating dampers in the ducts. This motor is actuated by a duct thermostat set to take a maximum amount of outside air at 60F and reduce the volume as the temperature rises. The low limit is set for 38F which will close off the outside air entirely to protect the coils and the water sprays in the system from freezing.



Air handling unit is at the left. At right are the evaporative condenser and W. K. Jamison, Engineer, Bard, Incorporated.

Dust as an Industrial Health Hazard

F. W. HUTCHINSON

Assistant Professor of Mechanical Engineering, University of California, Berkeley, Calif.

THE health problem arising from dust in industry is one of increasing seriousness. Socially, economically and legally it has become evident that immediate steps must be taken to combat the hazard represented by wholesale industrial exposure to the pneumoconiosis-producing dusts. Pneumoconiosis, in many of its forms, is incurable. Thus consideration of the problem which it represents is based largely on methods of dust reduction and removal and is therefore as much a responsibility of the engineer as it is of the physician.

Fortunately, medical knowledge and engineering equipment have progressed to such a point that recognition of hazardous conditions and availability of methods for correcting them will now permit a complete, practical and economical solution of the problem. Unfortunately, prejudice and fear have surrounded the entire subject with such an aura of suspicion and distrust that neither workmen nor employers have until recently been willing to acknowledge the hazard or recognize the need for preventive measures. In addition, the slow action of the disease coupled with failure on the part of many physicians to acquaint themselves with the proper diagnostic methods has made it difficult for the worker to establish his claim for compensation in the event of lung injury and equally difficult for the employer to defend himself against fraudulent claims; it has been said that silicosis claims constitute one of the most widespread of legal rackets.

Workmen have bitterly opposed adoption of the exacting employment qualifications and periodical physical examinations of those exposed to dust which are essential to medical control. Yet, it is essential that persons having a predisposition to tuberculosis or a low nasal filtering efficiency be excluded from the dusty trades. Similarly, protection of the worker demands that he be removed from exposure at the first indication of lung damage.

Employers, on the other hand, have adopted the point of view that most claims of silicosis are unfair and an unscrupulous attempt to take advantage of them. The explanation behind an employer's unwillingness to acknowledge the hazard is not unreasonable. The dust diseases are almost invariably of long duration and frequently are not discovered until many years after exposure has ceased. Thus many employers are now in the difficult and alarming position of facing claims for disease which is a result of exposure to conditions that existed in their plants 10 or 15 years ago; at that time they were unaware of the health hazard associated with dusty atmospheres and consequently, though they might have had every desire to furnish their employees with full protection from occupational injury, they did not take the "special care" which is now known to be necessary. Wilson states: "Most well-intentioned employers may be said to have used 'reasonable care' in past years and—considering their lack of knowledge—this is now their best defense in damage suits. However, from now on, with the spread of . . . available knowledge . . . only 'special care' will safeguard the interests of employer and workman alike."

Recent interest in dust diseases has built up an extensive literature; theories have been confirmed with experimental evidence and innumerable case histories of individuals and of entire groups are available. In contrast to the widespread ignorance of ten years ago, it would probably be difficult at the present time to find a worker in the dusty industries who has not at least heard of silicosis, or an employer who is unaware of the crippling damage suits which will face him if his employees, through failure on his part to take the necessary preventive measures, contract the disease.

The cost of dust control is often far less than the cost of one damage suit. Jury awards in silicosis cases of $10,000, $17,000, $22,500, $25,000 and like sums are matters of record. In the St. Louis area alone there were, some time ago, over 2000 suits pending. A Missouri mining company, as another example, faced claims aggregating $5,000,000 and spent $500,000 in out-of-court settlements of a few of them.

The purpose of this article is to review the literature on the physiological effects of some of the hazardous industrial dusts and to summarize present-day criteria acceptable as a basis for the design of dust control systems.

Silicosis

Silicosis is a disease of the lungs caused by the inhalation of dust containing free silica. Some authorities believe, but this fact has not been established, that the inhalation of silicates is also a causative factor.

Incurable and Progressive. The important facts about this disease are that, for practical purposes, it is progressive and incurable. The qualification "for practical purposes" is necessary because recent investigations suggest that uncomplicated silicosis is not progressive; however, the continued existence of a case of silicosis without the onset of complications is so rare that, from the standpoint of social consequences, the disease can in itself be regarded as progressive. In the medical literature the "progressive"

viewpoint is the one which has been most widely adopted but the possible future significance of the recent findings is promising.

With reference to the "incurability" of silicosis, recent work has also indicated the possibility of a solution but it is as yet too soon to hold out hope for satisfactory medical treatment. One promising method consists in the administration of thyroxene; the investigators report that:

> "Thyroid therapy may possibly not only prevent the development of silicosis, but may also arrest its further progress and possibly reduce to some extent the degree of fibrosis already existing."

The above remarks on the "progressiveness and incurability" of silicosis have been included because they show how very far the medical profession has yet to go to achieve a solution of the silicosis problem. In terms of concrete present-day gain, the sum total of the best that medicine can now offer is not of much value. When dealing with contagious diseases such as smallpox and Spanish influenza, it has been possible to achieve a satisfactory treatment as a first step toward the elimination of the disease itself; in the case of silicosis, a non-contagious disease, the only advance of real significance which is possible is an advance which must be brought about by the application of basic engineering principles—the reduction of dust concentrations at the breathing zone to a point such that a health hazard no longer exists; only in this way can silicosis be eradicated.

If permitted to run its course without complication, silicosis will lead to death by suffocation—the lungs becoming incapable of maintaining a gas transfer sufficient to sustain life. Usually, however, termination occurs as a result of complications such as tuberculosis or heart disease; a definite correlation has been established between silicosis and tuberculosis, but an explanation is, as yet, lacking.

With reference to tuberculosis a study of axe grinders and polishers showed a death rate of 1,900 per 100,000 from tuberculosis as contrasted with 150 per 100,000 for the general population of the same state. In this study the death rate of all workers in the dusty trades investigated was used. More striking figures and more significant ones were obtained from a Massachusetts investigation in which the tuberculosis death rate of 961 silicotic quarry workers was compared with that for the general population and found to be forty times as great.

Background and Extent. The name silicosis is of relatively recent origin, but the existence of the health hazard associated with dusty work has been recognized by medical men for many centuries. From the literature of the period we find that the Ptolemies knew of it. Pliny the Elder referred to the "stone cutters' disease" and devised a crude respirator for the protection of miners; Aristotle warned Greek workmen against the inhalation of dust. Hippocrates, three centuries before Christ, noticed that his surgical knives were dulled by dust in the lungs of stone workers. In the 16th century Georges Agricola, a mining engineer, wrote "De Re Metallica" and, with reference to dust, warned his readers to beware because it "penetrates into the windpipe—eats away the lungs—implants consumption in the body." He called attention to the fact that the death rate among Carpathian miners was so great that a wife could often outlive six husbands.

The passage of time has done little to alleviate the hazard. The development of pneumatic tools has led to a great increase in the dust concentrations attending the grinding, polishing and cutting of stone. The death rate among Barre granite cutters, for example, increased from 1.5 per 1,000 in the year 1890 to 19.6 per 1,000 in 1924, an increase attributable to the introduction of pneumatic equipment. When one realizes that a threshold concentration of 5 million particles per cubic foot is required to constitute a silicosis hazard (for dust made up of 100% free silica), it is then evident that there are many industrial operations today which represent health hazards that did not exist prior to the introduction of mechanical equipment.

Many estimates have been made of the number of persons exposed to hazardous concentrations of silica dust, but such estimates are usually based only on industrial exposure. When account is taken of the fact that 60% of the earth's crust consists of silica the likelihood seems great that such estimates are conservative. Lanza and Vane estimated that the number of industrial workers exposed to the silica dust hazard is in excess of half a million in those industries in which the processing or handling of siliceous material is of basic importance; this estimate does not take account of the many workers exposed as a result of the industrial use of silica as a filtering agent.

In one other respect the silicosis hazard has not yet been evaluated. As already mentioned there is a definite relationship between silicosis and tuberculosis. This fact leads to the probability that in any community in which there is a large number of silicotics there will be a decided familial tuberculosis hazard. Fortunately, however, this danger is somewhat lessened as a result of the long incubation period which is found with silicosis—by the time a workman's lungs have reached the stage at which tuberculosis is most likely to set in it is more than probable that his children will have grown past the age at which the danger of their contracting the disease is greatest.

That silicosis is definitely related to a particular kind of occupational risk is demonstrated by the data from examinations (X-ray) of 2500 workmen from all departments of a typical "heavy industry"; 5.8% had silicosis, but 90.0% of those affected were foundry workers. The great importance of the silica hazard is clearly indicated from the following comparative mortality figures (from a 1933 publication of Hollis and Yule):

1000 for standard population (all causes for ages 20-65)
1984 for silica group
967 for non-silica group

The silica group (above) showed only three causes of death (diabetes, appendicitis, digestive diseases) which did not differ significantly from the general group. The significance of these figures is at once apparent when it is considered that an estimated 110,000 workers in the United States have silicosis in some degree.

Development of the Disease. The time required for incapacitation due to silicosis has been the subject of a great deal of attention, but as yet no generally accepted conclusions have been reached. Apparently the period of exposure preceding contraction of the disease is a function of the dust concentration, nature of the dust, nature of the work and individual physical idiosyncrasies. From a study of 9,800 stone-cutters in the Ruhr it is concluded that 13 years exposure are required to show slight silicosis and 20 years to cause incapacitation. This same study reveals that 63% of the deaths among silicotics occur from tuberculosis complications. In porcelain workers silicosis develops slowly but progressively; the second stage is usually not reached until after 10 years. Among sandstone workers the minimal exposure has been found to be 11 years while for iron miners an exposure of 4 to 5 years may be responsible for the appearance of lung changes 4 to 8 years after the exposure has ceased. In contrast to the above relatively long incubation periods are those found among workers engaged in sand-blasting and in the manufacture of abrasive soaps; in these occupations only 3 or 4 years may precede the onset of the disease. Likewise, an examination of 175 men engaged in rock drilling showed that 50% were affected in less than one year.

There is a good reason for believing that under particularly heavy dust concentrations silicosis takes an acute form and may appear after an exposure of only a few months. Not soon forgotten will be the case of the Hawk's Nest Hydro Plant on the New River. Some 4000 workers, mostly negroes, were employed for wages of $3.00 for a 13-hour day; in a relatively short time after completion of the tunnel work 475 of them were dead and an estimated 1500 others incurably ill. This case was investigated by a committee in the House of Representatives before whom witnesses testified that, "In the tunnel 10 drills were in operation at once and you could not see ten feet ahead of you even with the headlight of the donkey engine". Workmen were so thoroughly covered with a silica dust that "you could not tell a white man from a colored man, 15 feet away". It was this case that a senator from West Virginia described as "the most horrible industrial disaster in the history of the world". It was of this case that Representative Marcantonio of New York charged that 169 workers had been buried unidentified because the undertaker had "lost" his records. On the basis of all evidence which has yet been brought forward it would seem to the impartial investigator that the Hawk's Nest Tunnel should remain a tragic reminder to the engineer of the need for consideration of human values in the solution of engineering problems.

The above case is only one of a number of similar but less sensational cases which have shown that there is a real possibility of contracting an acute form of silicosis if work is in an atmosphere having an extremely high concentration of siliceous dust. Experimentally the possibility of acute silicosis has been demonstrated by laboratory tests on animals; for exposures of eight hours a day to concentrations of 200 million particles per cubic foot or more it has been shown that the last stage of silicosis may be expected in a relatively short time.

Size of Hazardous Dust. The importance of particle size in determining the hazard associated with dusts has received a great deal of attention. Particles 25 to 30 microns in size will usually settle out rapidly and are therefore not likely to be breathed in quantities sufficient to constitute a hazard. However, particles of this magnitude (such as pollen of the Giant Ragweed or wood dust in carpenter shops) may be responsible for hay fever or for various types of asthma. In general, particles greater than 10 microns are caught in the trachea, large bronchi and mucous membrane. Particles around 5 microns go to the respiratory tract, but few of them reach the alveoli where the 1 micron particles are most numerous. Policard made a detailed examination of the lungs of two silicotic miners and found that 50% of the particles were less than .4 micron and 75% less than 1 micron; his findings should be used with care, however, because it is very probable that the dust distribution in the lungs is a function of the distribution of particle size in the inhaled dust—thus Policard's findings may be applicable only for the conditions under which the men whose lungs he examined had worked. The smaller particles are obviously the most dangerous since, on a weight basis, they offer a much larger surface than do the larger ones. For this reason dust counts are of more value in evaluating the hazard associated with a dusty environment than are gravimetric dust determinations.

The dust particles that are most effective in the causation of silicosis are of a magnitude so small that they are not perceptible to the human eye. A micron is 1/1000 of a millimeter or about 1/25,000 of an inch. As has been shown, the particles most important in silicosis are in the neighborhood of .5 micron or 1/50,000 of an inch—this represents a dimension of the same order of magnitude as the wave length of that form of radiant energy which we recognize as light. If one cubic inch of quartz were broken into cubes .5 micron on a side enough particles would be formed to create a silicosis hazard in a 250,000 cubic foot space.

The determination of mean dust sizes was the purpose of a series of comprehensive studies conducted by the U. S. Public Health Service: examination of 18,000 outdoor dust particles showed the median size to be .5 micron—nearly all were less

than 1.0 micron; in contrast, only 21% of 6,000 industrial dust particles were less than 1.0 micron, the majority being between 1 and 3 microns and the mean 1.5 microns.

Hatch and Moke investigated foundry dusts and found that composition is a function of particle size: the proportion of combustible matter and acid soluble iron, carbonates, etc., increase with decreasing size; the proportion of clay and other silicates varies without a definite trend with size; the quartz becomes less as the size decreases and for particles under 2 microns (which comprises 90% of the total number) it is from 1/5 to 1/25 of that found in the particles greater than 10 microns. These findings emphasize the necessity of taking dust samples directly from the contaminated air and not utilizing "rafter" or any other kind of settlement sample which does not contain a representative size distribution.

Hazardous Concentration. Permissible concentrations of dust vary with size, composition, and the dust retention characteristics of the individual. The latter factor is one which offers some hope from the standpoint of preventive medicine. Practically all that is known of the dust retaining characteristics of the human nose is attributable to the work of one man—G. Lehmann. This experimenter has shown that the dust fixation in the nose varies from 2% to 75% and is almost completely independent of such factors as the condition of the nasal secretion, the rate of air currents, the degree of concentration or chemical composition of the dust, the width or narrowness of the nasal passages; seemingly, fixation is a function of the vortex formation and rebound after passage through a restriction.

A correlation between fixation and silicosis would seem to follow from the following tests: Of 46 stone cutters with fixations above 40% only two were found to have silicosis; of 31 stone cutters with fixations less than 29% only 2 were healthy. After examining the above data Lehmann concludes that, "applicants for work with poor dust fixation capacity should not be allowed to work where a menace of silicosis exists".

As a result of 418 experiments with magnesium oxide and calcium carbonate, Carlton E. Brown gives the following relationships between dust retention and other factors:

Per Cent Retention is inversely proportional to

1. Respiration rate for rates below 20 per minute. An increase above 20 per minute is apparently followed by no changes in per cent retention.
2. Minute-volume of air breathed. This probably results from increase in respiration rate with minute-volume.

Per Cent Retention is unaffected by

1. Volume per respiration.
2. Vital capacity.
3. Relative humidity.

The same investigator found that the percentage of magnesium oxide retained during normal breathing while at rest varied little from about 60% at a concentration of 10 mg. Above 10 mg. the retention changed but little, but as the concentration dropped below 10 mg. the retention rapidly approached 100%.

The relation between dust concentration and the incidence of silicosis has been studied by many investigators, but no general empirical relationship has as yet been established. One commonly used rule (proposed by Drinker) recommends the acceptance of 5 million particles per cubic foot as the minimal permissible dust concentration for pure silica and 50 million particles per cubic foot for dusts that are very low in silica. Some evidence suggests that this rule is unduly conservative for dusts which contain little silica and an alternative which is widely used is to limit the total dust count to a value such that the product of the dust concentration by the percentage of silica be less than 5,000,000; this rule gives 100,000,000 particles per cubic foot as the minimal concentration for non-siliceous dusts.

Physiological Effect. The lung condition known as silicosis results only from the inhalation of silica-bearing dusts. Why silica possesses the ability to bring about this condition has been the subject of much investigation and theories of silicosis are at present responsible for considerable controversy. Physiologically—excluding the effect of complications—silicosis affects the normal functioning of the body in the same way that the formation of scale affects the efficiency of a heat transfer device. In the heat exchanger the hot and cold fluids are separated by an exchange surface and the deposit of scale on this surface reduces its effectiveness as an exchange medium. If the scale becomes sufficiently heavy it will be impossible to secure the transfer of enough heat to accomplish the purpose for which the exchanger was installed; similarly, the lung is a surface through which oxygen is transferred from the air to the blood. The formation of scar tissue reduces the effective transfer area and eventually the lung is unable to accomplish its purpose—death from suffocation is the result.

Asbestosis

Asbestos dust is second only to free silica in the magnitude of health hazard which it represents. Asbestos is a fibrous material of varying composition, but is usually made up of approximately 43% magnesia, 40% silica and 14% water. Oxide of iron is frequently present and appears as dark particles among the translucent fibers—the fibers are of such length and fineness that cloth weighing less than 8 oz. per square yard has been made from them.

The lung condition resulting from the inhalation of this dust is known as asbestosis and resembles silicosis in its main clinical aspects, but differs due to the enhanced rate of development. Under average industrial conditions the length of employment in fatal cases is only about one-half that which is usual

for silicosis. It is estimated that there are in the United States approximately 10,000 men exposed to this hazard as a result of work in the insulating, asbestos cloth, and similar industries. As is true of the silicosis exposure estimates, this figure does not take into account the number of persons exposed as a result of employment in the process industries where asbestos finds use, under various trade names, as a filter aid. In one respect asbestosis is less deadly than silicosis—that is, there is seemingly a lower susceptibility to the supervention of pulmonary tuberculosis. The danger of contracting the disease is apparently not influenced by either age or sex. Like silicosis, it is incurable and progressive; a case is reported of a patient who was exposed to asbestos dust for one year and whose sputum showed the presence of asbestosis bodies fourteen years later.

Very few data are available on the relation of dust concentration to the incidence of the disease. No minimal safe concentrations have yet been set up and information is scant as to the conditions in those plants where a hazard is known to exist. It has been determined, however, that the asbestos dust encountered in fabricating plants is free of silica when air is floated at the breathing level and that the danger of the dust increases as the quality or length of the fibers increases.

Miscellaneous Siliceous Dusts

Many siliceous dusts other than quartz and asbestos have been carefully investigated. Talc—a silicate containing 62% silica—has been shown to be responsible for a form of pneumoconiosis when inhaled in large quantities. One group of investigators report that 50% of the talc workers whom they examined were affected and about 12% had tuberculosis. The same report shows that talc containing 10% tremolite is much more dangerous than talc containing 40% tremolite, but an explanation is lacking.

The action of cement on the lungs is not definitely known. German investigators say that it produces only an inert deposit in the lungs, but American reports show that the frequency of disability from respiratory diseases in cement plants is about double that found among employees in non-dusty manufacturing plants; absence from work was also twice as frequent. Yet animal experiments show that cement like limestone and gypsum produces an adsorptive reaction; the dust disappears from the peritoneal cavity without the production of scar tissue.

Slate (1/3% quartz) in concentrations of 700 million particles per cubic foot produces a fibrosis and pneumoconiosis, but few cases have been known to progress seriously. On the other hand, there is reason for believing that clay and slate dusts are responsible for a high incidence of tuberculosis.

Italian investigators have studied the dust hazard in cotton spinning mills and report that the silicosis hazard is apparently negligible. Mineralogic analysis of such dusts brought to light the interesting fact that their composition is similar to that of the soil in which the cotton was grown.

Non-Siliceous Dusts

Apparently there is a great difference of opinion as to whether or not non-siliceous dusts are harmful either to normal or tubercular persons. The data are so scant that a review of the literature must consist essentially of a catalogue of the few and scattered investigations that have been made of particular dusts. General conclusions can not be drawn and an extension of available data to dusts of even the same mineral family is hazardous.

German investigators have studied a number of different carbon dusts and rate them in the order of hazard which they represent: lignite, coal, graphite, charcoal, soot.

A statistical study of the health hazard in a large American company which manufactures artificial abrasives led to the conclusion that persons who have had pulmonary tuberculosis should not be allowed to work where they will be exposed to dust from abrasives. The dust in this particular plant was aluminum oxide combined with silicon carbide and the incidence to tuberculosis was 1 1/2 times as great in the dusty departments as in the non-dusty. In this connection it is interesting to note that other investigators had previously reported aluminum oxide as not being a factor in the production of silicosis —thus a distinction must be drawn between the fibrosis-forming ability of a particular dust and its danger through increased susceptibility to pulmonary tuberculosis. This leads to the conclusion that the claim is unwarranted that a dust is not harmful merely because its reaction on lung tissue is inert.

The U. S. Public Health Service has grouped dusts (siliceous as well as non-siliceous) in three classifications:

1. Those causing an inert reaction, the amount of dust in the peritoneal cavity remaining approximately constant: soapstone, carborundum, jeweler's rouge, anthracite coal, bituminous coal and precipitator ash.

2. Those causing a proliferative reaction, nodules continuing to increase in size: quartz, chat and flint.

3. Those causing an absorptive reaction, dust disappears from the peritoneal cavity, but scar tissue is not formed: calcite limestone, precipitated calcium carbonate, gypsum and cement.

A similar list of dusts has been prepared by Haynes who carried on a long series of animal experiments. He arranges them in order of toxicity as follows: precipitated silica, flint, slate, hydroxide, precipitated chalk, magnesium carbonate, carborundum, calspar, emery, colloidal coal (in massive amounts).

All of the respiratory disorders discussed above, together with many others which are caused by the inhalation of fibrosis-forming dusts, are grouped under the one broad term Pneumoconiosis.

Ventilation for Welding Booths

M. E. RINGQUIST
Engineer, The Trane Company, La Crosse, Wis.

Steps in the design of a system for properly ventilating welding booths at an adult vocational school in La Crosse, Wis.

TYPICAL health hazards associated with welding were the most complex of all the problems to be coped with in setting up the welding shop for the Vocational and Adult Training School, La Crosse, Wis., to operate on a full twenty-four-hour-a-day basis. The most prevalent of the hazards was proper ventilation of the individual welding booths in which the students were trained.

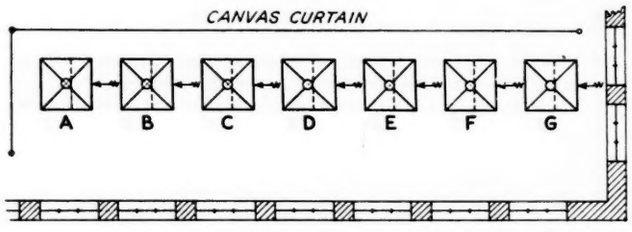


Fig. 1. General layout of the booths.

The individual booths were so set that table welding, overhead and shoulder height welding were permitted. Sides of each booth were made of masonite Presdwood fastened to an angle iron framing. Each booth was fastened to the floor and for rigidity all booths were tied together with an angle iron. In each booth is a table or work bench made of heavy iron plate, and supported on the booth frame at a point 36-in. above the floor. Space from the table top to the top of the booth, a distance of another 36-in., was left open.

Around the group of booths was placed a heavy canvas curtain to safeguard the eyes of others in the room from the ultra-violet rays of the welding arc.

Since there are three points at which fumes would be produced, it was not possible to catch the gases immediately at the source. Instead, a practical compromise had to be found to catch most of the fumes as quickly and as close to the source as possible. A simple type of floor sweep hood was not practical since it did not cover the area required. A comparatively high velocity slot exhaust covering the working area seemed the most effective plan. Air flow into the welding booth by means of this exhaust would be away from the welder, as shown in Fig. 2. Fumes would thus rise to the top of the booth and into the high velocity slot.

A canopy type hood was used with 60° sloping sides and tapered from a square bottom to a round top. The hood was mounted with the bottom approximately 6-in. above the top of the booth to give additional head room. Booth and the hood were sealed airtight around the sides and the back by connecting the two with sheet steel. Details of this hood are shown in Fig. 2.

In the hood near the bottom and fastened to the back of the hood was mounted the baffle. Space was left open along the two sides and part of the front. Part of the front was blocked off to permit mounting the light inside the booth.

Basing the selection of air volume per booth on the recommended figures for ventilation of confined spaces, a figure of 750 cfm was chosen. This volume divided by 500 fpm (the chosen velocity) results in a figure of 1.5 sq ft. This is the approximate area of slot through which 750 cfm of air will pass per booth. The velocity is indicated as a chosen velocity. It approximates the continued upward air move-

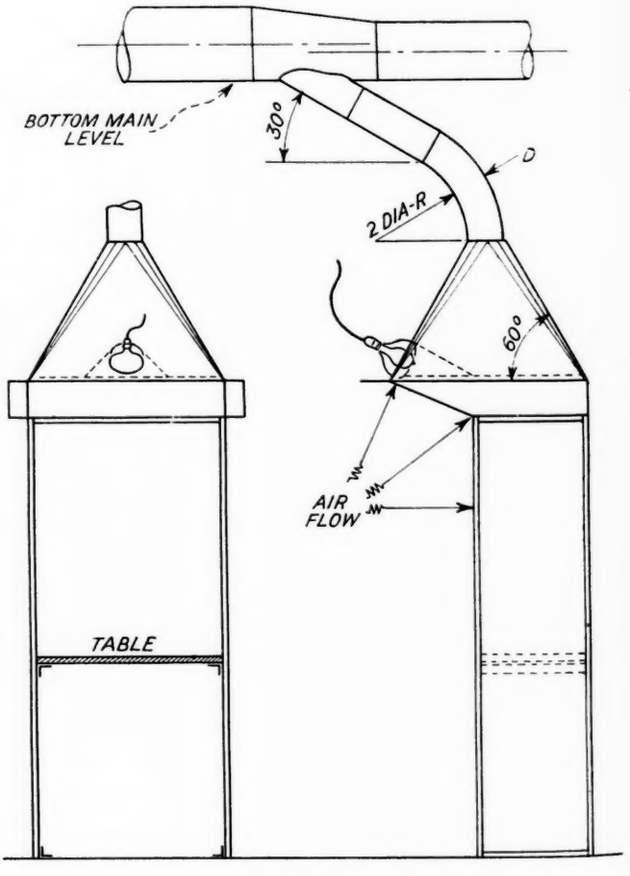


Fig. 2. Details of a booth setup.

ment, since it was not necessary to overcome a terminal settling velocity, or to transport particles in the vitiated air.

Even though welding fumes are of greater density than the atmosphere into which they are discharged, the fact that they are warm enables them to rise. Therefore, it was only necessary to continue that upward movement of fumes.

Step two in the design of the system is to establish the resistance pressures, the branch and main duct sizes, and to compute by means of the design, the balance of the system. A convenient chart may be drawn for recording resistance pressures, velocities and points of balance, as shown in Fig. 3. The line diagram associated with the chart is a convenient means for determining piping lengths and also shows points at which balance is to be effected.

Entrance loss into the hood may be found by considering the slot as an orifice in a thin plate. This loss plus that through the hood itself may be recorded in the table under O. L. (orifice loss). Computations are as follows:

Velocity pressure at 500 ft per min equals 0.02-in of water.

The loss through an orifice in a thin plate (from the *Guide),* 2.5 to 3.0 times the V.P. (velocity pressure).

Therefore, 3.0 x 0.02 equals 0.06-in of water.

Entrance loss through the hood itself is 0.20 V.P. or 0.20 x 0.49, the velocity pressure representative of the velocity in Branch A-1. This equals 0.098 or 0.10-in of water.

Therefore, the total loss of head is 0.06 plus 0.10, or 0.16-in of water.

By using the same volume for each hood and varying the velocity in the branches and in the mains, a balance (equivalent resistance pressure) may be obtained at the strategic points 1, 2, 3, 4 and 5, as shown in Fig. 3.

In all cases, the resistance pressure may be computed by using the number of pipe diameters in the straight pipe plus the equivalent diameters for the elbows (bends), and then dividing this total by a factor K (length in pipe diameters equivalent to one velocity pressure). For Point A to 1, the per cent of the V.P. is 0.340. This is obtained by dividing the total length in pipe diameters 20.4 ÷ 60 (K for a 7-in pipe). Then, 0.340 x 0.49 (V.P. for Branch A-1) equals 0.167-in of water. O.L. plus R.P. equals the total loss of pressure that is present in A-1 or 0.332-in. of water.

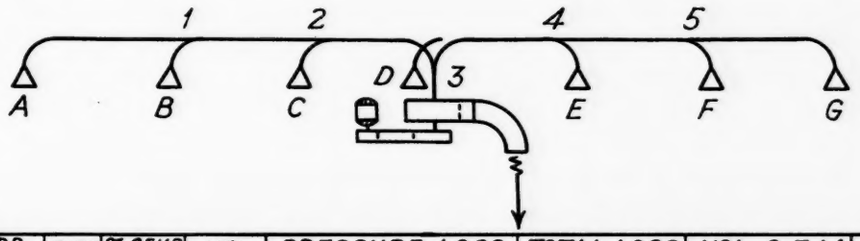
For Branch B-1, the velocity must be raised to obtain the same loss of pressure in B-1 as in A-1 (balance point). This can be done by decreasing the size of the branch. Then, too, the volume in the two branches must be kept the same.

Likewise, in the case of A-2 against C-2, A-3 against D-3 and so on, the balance must be obtained as closely as possible to obtain the distribution of volume throughout the system. Points of balance are indicated by the two-pronged arrows.

In selecting the proper fan and motor, the first consideration, of course, is the air volume to be handled. After the total air volume has been determined, which in this case would be 750 x 7 or 5,250 cfm, consideration must be given to the static pressure to be maintained by the fan in order to produce air flow. In this design, the total pressure that must be maintained to provide air flow would be 0.793-in from Fig. 3 loss through the fan and the

K = LENGTH IN PIPE DIA. TO ONE VELOCITY PRESS

3"	40 DIA'S
4"	45
5"	50
6"	55
7"	60
8"	65
9"	70
OVER	70



DUCT	No.	DIA.	LENGTH FT.	LENGTH DIA.	ADD DIA'S BENDS	PIPE DIA.	%OF V.P. = DIA'S / K	VEL F.P.M.	PRESSURE LOSS V.P.	PRESSURE LOSS R.P.	PRESSURE LOSS O.L.	TOTAL LOSS BR'CH	TOTAL LOSS MAIN	VOL C.F.M. BR'CH	VOL C.F.M. MAIN	FACE VEL
	A	7"	4.8	8	12.4	20.4	.340	2800	.49	.167	.06+.10	.327		750		500
	B	6½"			8.9	8.9	.161	3250	.66	.11	.06+.10·13	.410		750		500
B-C	1-2	9½"	3	3.7		3.7	.053	3050	.58	.03			.440		1500	
	C	6½"			8.9	8.9	.161	3250	.66	.11	.06+.10·13	.410		750		500
C-D	2-3	11½"			30	30	.428	3110	.60	.257			.697		2250	
	G	7"	4.8	8	12.4	20.4	.340	2800	.49	.167	.06+.10	.327		750		500
	F	6½"			8.9	8.9	.161	3250	.66	.11	.06+.10·13	.410		750		500
F-E	4-5	9½"	3	3.7		3.7	.053	3050	.58	.03			.440		1500	
	E	6½"			8.9	8.9	.161	3250	.66	.11	.06+.10·13	.410		750		500
E-D	5-3	11½"			30	30	.428	3110	.60	.257			.697		2250	
	D	5½"			8.7	8.7	.166	4550	1.28	.213	.06+.26	.793	.793	750		500

Fig. 3. Form of chart found helpful for recording data to balance the system.

discharge to the atmosphere. The selection was made based on one inch of static and 5,390 cfm which allows a little additional air for leakage.

A general conclusion would be to use a fan with a non-overloading power characteristic. For this installation a general 1½ hp motor was selected with a speed of 1,800 rpm, the brake horsepower on the fan being 1.22.

On test, it was found that the velocity through the slots into the hoods varied from 400 to 600 fpm and the balance between the two ends of the main was within 7% of being exactly the same. The resistance through the hoods was found to be 10% above calculated values.

To obtain some idea of the effectiveness of the system as a general ventilating system for the room, a yellow sulphur smoke bomb was discharged into the welding area around the booths while the fan was idle. Eight minutes after the fan was started, with no welding being done, the room had cleared to normal clarity.

Total volume of the room is 31,000 cu ft. With a total of 5,390 cfm being exhausted, there would be ten air changes in the room per hour. The number of air changes per hour for a garage where gases of greater toxicity are handled, should be 12. The system, therefore, is effective as a ventilating as well as an exhaust system.

Ventilation for Radium Dial Storage

Ventilation of spaces where radium dial instruments are stored has been found necessary, according to C. R. Williams and R. D. Evans, writing in a recent issue of the *Journal of Industrial Hygiene and Toxicology*.

The authors concluded that: (1) The number of dials in any one location should be kept to an absolute minimum (preferably below 1000 instruments); (2) The dials should be well scattered. It is advisable to keep the distribution on a horizontal rather than a vertical basis. Shelves should not be more than six feet high for vertical storage; (3) Dead spaces should be avoided. If possible, storage shelves should be located so that maximum air movement is through the aisles between the shelves. If space permits, the aisleways should be at least 36 inches wide; (4) Dials should be kept on open shelves to prevent the accumulation of radon gas. Ventilation is required for closed cabinets; (5) If dials or instruments are stored in a confined area, ventilation is imperative. Ventilation requirements—360 cfm for each 1000 dials. With some instruments from two to ten pointers will contain as much radium as the dials. With the completed instrument the ventilation should be increased accordingly up to 30%; (6) Workers should be instructed to spend only an absolute minimum of time in the areas where radium dials or instruments are stored.

Off Again, On Again

AIR currents sometimes behave in peculiar ways. For example, consider the following occurrence:

The total air handling capacity of the fans was 202,000 cfm. The supply fans were of the multiblade type and consisted of four 21,000 cfm units, three 35,000 cfm units and one 10,000 cfm unit. The remainder was in small exhaust units.

The fan with which we are concerned was one of the 21,000 cfm units and was located on the ground floor. It was of top up angular discharge and was direct connected to an electric motor.

The discharge was connected into the side of a duct (or rather combination duct-plenum, since its cross section was uniform throughout), located over the corridor ceiling and running the length of the corridor—some two hundred feet. This duct was about thirty inches deep and eight feet wide.

Branches were taken off the side of the duct at 90 degrees, each being provided with a deflector-volume damper. For the upper stories, these branches connected to risers while for the ground floor, they led through the wall into the rooms.

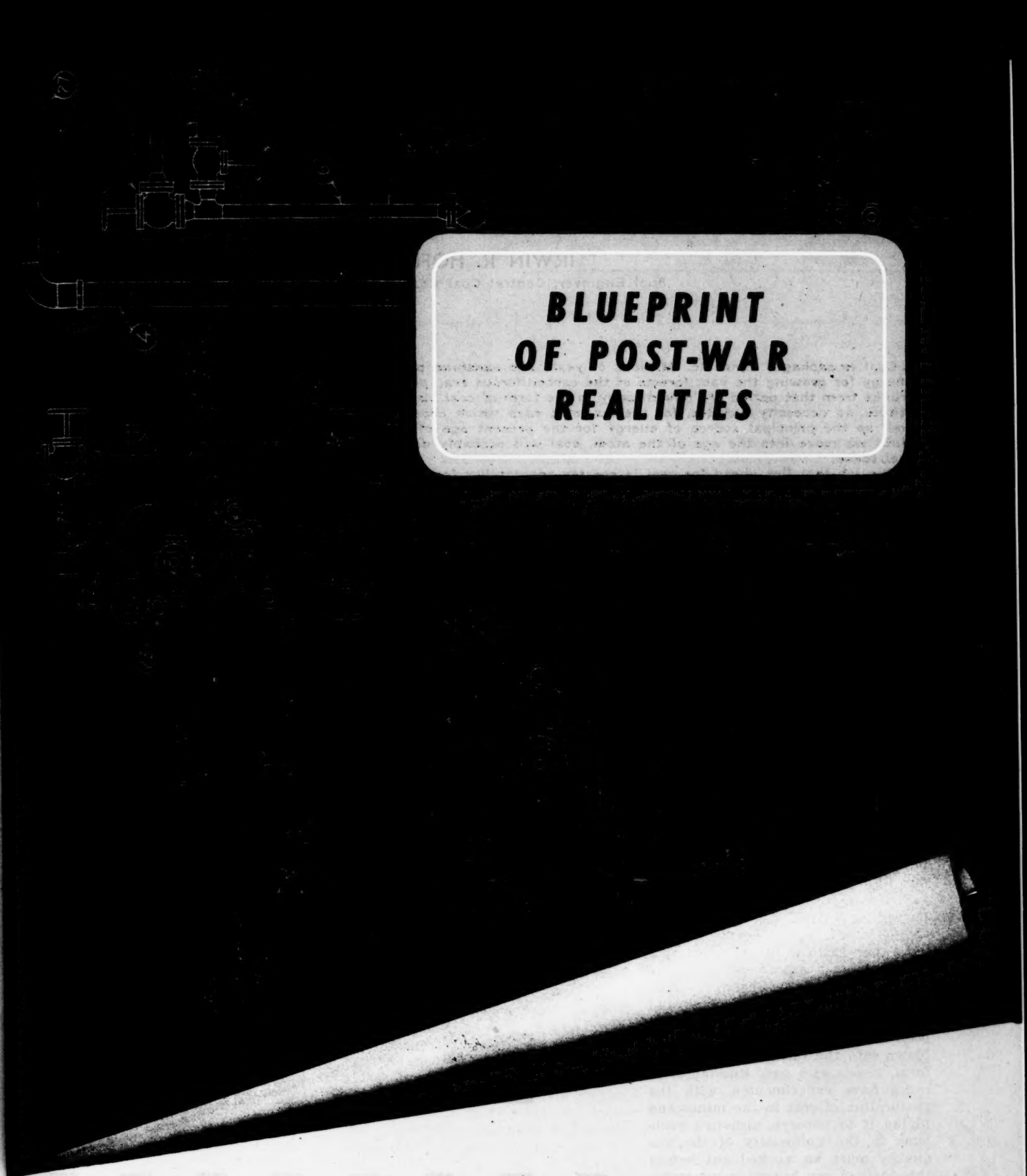
One of the openings, about one-third of the duct length away from the fan, supplied air to a ground floor room and, although the damper was wide open, this opening failed to deliver any air whatever; nor was there any indication of back flow. The inside of the branch was visible right back to the duct, and was without obstruction of any kind. The writer had been through the duct and that was clear, also.

The damper was set in various positions, but no matter what was its direction, no change in the air condition resulted. After vainly trying to secure a satisfactory adjustment, for some ten minutes, the damper was quickly closed and then opened again.

A satisfactory air flow was obtained immediately and the quantity was easily adjusted.

The system has now been in operation for over thirty-two years and no further trouble has been experienced with this opening.

No explanation of this phenomenon is offered because none is known. What caused the condition and why closing and opening the damper eliminated it, remains a mystery. Whatever the condition was, it has apparently never since been duplicated.—*John J. Woolfenden, Engineering Staff, Smith, Hinchman & Grylls, Inc., Detroit.*



BLUEPRINT OF POST-WAR REALITIES

COAL FOR HEATING AND STEAM GENERATION

By IRWIN R. HOFFMAN
Fuel Engineer, Central Coal Company, New York, N. Y.

Coal for Heating and Steam Generation

IRWIN R. HOFFMAN
Fuel Engineer, Central Coal Co., New York, N. Y.

Coal is packaged sunshine. Millions of years ago sunshine provided the energy for growing the vast forests of the carboniferous era; petrified tree trunks from that period are mined today in the form of coal. It is our substitute, as necessity dictates, for the warming rays which produced it, as well as the principal source of energy for the present age of electricity. Until we move into the age of the atom, coal will probably dominate the fuel scene.

The job that lies ahead for coal is greater adaptability for effective and convenient use, the conversion of more fuel energy into useful heat and, an important corollary, the elimination of waste. The war effort has strongly emphasized these aims.

We have come a long way since Pearl Harbor, and the outlook daily grows brighter. As the war in Europe approaches its close, the impression that we have come far is heightened by the knowledge of accomplishment. We can begin to make post-war blueprints.

A Picture of Coal

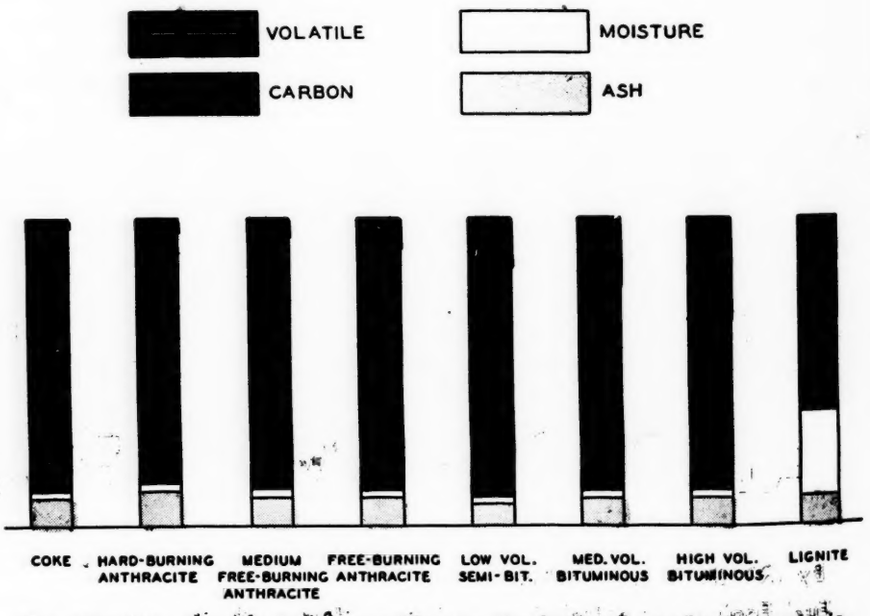
CONTINUING coal research brings us ever nearer our objectives. As a safe and automatic fuel in the field of heating and steam generation, coal's adaptability has grown with the development of improved combustion methods and with the growing feeling of dependence on coal's reserves. These have helped make the production of coal mined in the United States exceed the combined value of all gold, silver, copper and iron produced here.

Coal is a versatile fuel. It may be burned as a solid, liquid or gas. In the field of house heating alone, more than half the 40 million private dwellings and apartment units receive their heating comfort from solid fuels. Finely pulverized and held in colloidal suspension, coal has been fired in the form of a liquid; blown into the furnace in powdered form, it acts as a gas. Russian engineers have experimented with the gasification of coal in the mines and piping it to burners, although problems in the uniformity of the gas quality must be worked out before this method can become commercially practicable. Producer gas made from coal, as well as water gas and the products from carbonization and hydrogenation of coal, are other illustrations of coal's versatility as a fuel.

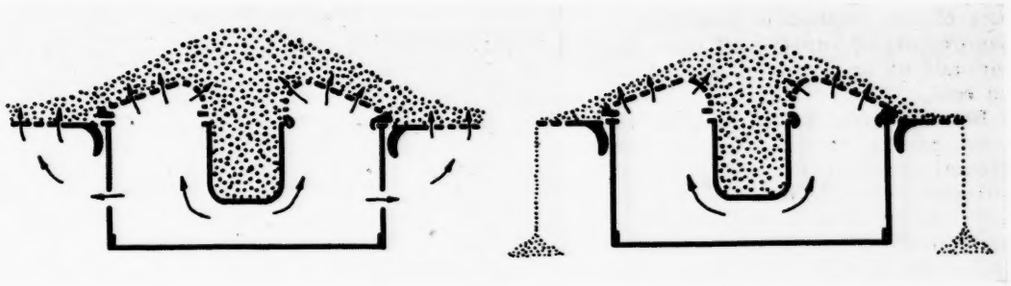
Some data on the classification of coals and knowledge of their burning characteristics are requisite aids when considering the fuel problem. This should be no less true of the home owner or apartment builder than of the engineer, architect and owner of commercial and institutional properties. While it is true that in some localities the choice of coal is limited, most fuel consumers may choose from a wide range.

Anthracite. Of all coals, anthracite may be placed in the front rank of desirable fuels due to its cleanliness. While it does not have the high heating value of bituminous, it burns without smoke and with a minimum of attention. The agglutinating, or caking, quality of anthracite is nil, thereby permitting easy passage of air during the burning process. For this reason it is not necessary to disturb the fire and, in fact, this feature is one of the requirements for good operation. The hard structure reduces degradation and permits easy flow, making anthracite an ideal fuel for automatic operation with bin-feed ash remover stokers. Burning qualities vary with the volatile content, but the differences in anthracite coals are not so great as in bituminous. Here and there an exceptionally hard structure coal may be found which is so hard to kindle that even Prometheus with the aid of fire borrowed from the sun's chariot might have experienced difficulty.

Bituminous Coals. Bituminous coals are higher in heat value, contain less ash than anthracite, and are readily adaptable to most types of coal-burning equipment. However, they have a tendency to cake together when burning and must be broken to keep the fuel bed porous for uniform air distribution. Low volatile coals, known as semi-bituminous or "smokeless", generally cake harder than medium or high volatile coals. They have a higher heating value and burn with less smoke than the latter. But strongly offsetting these properties is the more favorable burning characteristic of the higher volatile coals. These usually cake less and hence do not require as much breaking or attention. The importance of this feature cannot be over-estimated; it merits more attention than the data contained in coal analyses. For this reason increasing consideration is being given to the problem of neu-



Classification of coals by composition on the basis of proximate analysis.



(Left) Cross section of a bituminous burning retort stoker, showing air distribution, as compared with anthracite stoker (right).

tralizing the agglutinating properties of coal.

Caking of Coals. Mistaken impressions exist that caking coals do not expand in the fire, while coking coals exhibit both caking and expanding properties. The plain fact is that all bituminous coals expand and cake when heated. As applied to coal burned in the boiler furnace, caking and coking have the same meaning. In the coke industry, however, the terms have varied significance, and this is the basis for the misunderstanding.

Caking tendencies of coal can be reduced by carbonization, by partial oxidation, and by chemical treatment. Carbonization of bituminous coal produces coke, which burns without caking. Partial oxidation by the coking method of firing, admission of air below the plastic zone in stokers, and by pneumatic coal feeding reduce caking. Outcrop coals, due to weathering, cake less than deep mine coals. Weathering causes coal to lose some of its desirable burning characteristics through the absorption of moisture and from the slow oxidation process. Therefore, some mixtures of outcrop and deep mine coal can be used, each contributing qualities which are lacking in the other. Mixtures of coal with inert materials are also being studied for their effect on neutralizing agglutination. Chemical treatment includes soaking small samples of coal 14 days in a 1% aqueous caustic soda solution, then acidifying and washing. Exposing the coal to an atmosphere of chlorine weakens the agglutinant.

Coal's Present Situation

The present confusion in coal is due to greatly expanded demands by the war effort together with the shift from oil to coal resulting from rationing. The problem of adequate supplies far overshadows consideration of choice. But in spite of bottlenecks and labor shortages, coal production is rising. New operations are being opened and outcrop coals more generally considered. While the flow of coal is being accelerated, it is done at some sacrifice in preparation and quality. The added supply is welcome but it is not enough to satisfy the demand. The situation next winter may present problems more serious than the last. Consequently, heating and steam generating plants will have to make the most of whatever fuels are available. Some blends, welded of the very coals which are more plentiful than others, will surprise many with their economy, besides affording relief.

The shortage of anthracite in the east imposes an added load on bituminous coal, the production of which is about ten times that of anthracite. Many plants designed for hard coal have turned to bituminous. As an interesting consequence, the soft coal industry, aside from efforts of its own, is witnessing a tremendous educational campaign in its favor. In its wake will undoubtedly be a large number of converts, many of whom will remain from choice, and others from having it forced upon them through investment in equipment. Following the oil shortage, coal-burning installations were made in large numbers, equipment having been selected on the basis of delivery time, which was the compelling factor. As a result, prejudice against coal in some quarters is bound to be magnified and a wider variety of opinions expressed on subjects of handfiring, stokers and competitive fuels to a greater extent than ever before. But many who demanded convenience, reduced labor problems and lower steam costs may have found that coal is a surprisingly good solution of their problem. Post-war coal-burning methods will crystallize many impressions into conviction.

Post-War Vista of Coal

The post-war outlook of coal includes, first of all, cooperation from designers of heating methods. Fuel economy and heating comfort do not begin with the furnace; they begin with the load. Greater heating comfort at lower cost with added health safeguards calls for the elimination of overheating, alternate heating and chilling, excessive dryness, and improper temperature regulation. This can be accomplished by metering the heat input to each room by individual controls, combined with proper humidification of the air. A few years ago mechanical refrigeration in the residence and apartment was unheard of; now it is essential. In the post-war house and apartment personalized zone heating will be just as essential. Humidification provides comfort at lower temperatures; individual room controls insure proper heat. Both will contribute added health safeguards, reduce the amount of heat required and thus promote fuel economy.

In the post-war period important results can be expected from the 2½ million dollar coal research program, launched last September. In the forefront of this program will be the development of automatic coal burners and new combustion methods for greater adaptability in house heating units. From results attained by prior research it would seem that these merit serious recognition by the bituminous industry for making coal a convenient fuel. Coal as an almost limitless source for gasoline, gas from coal for the nation's pipelines and, from the popular point of view, new magics to rival nylon, the sulphas, plastics and the synthetic rubbers may be sketched into the post-war vista of coal. The Anthracite Institute, the Bituminous Coal Institute, and other laboratories of industry are engaging in research for the future.

It may well be that coal is heading into an era where it is destined to assume much of the load formerly assigned elsewhere. On the basis of events in the recent past, planners for the future will undoubtedly pay increased attention to the stability of coal as compared with other fuels, particularly from the standpoint of national policy.

National Trends. Deposits of coal are vast, compared with the present meager known oil reserves in the ground. The public view of oil as a national reserve of power reserved for aviation, automotive machines and industrial processes, but as ill-directed energy for steam boiler fuel may crystallize into national policy. Already in operation abroad, hydrogenation plants for producing liquid fuel from coal are in the experimental stage in this country. In the Axis countries the consideration of

cost of this method is secondary to the urgency of supply. All these factors add up to increasing dependence on coal.

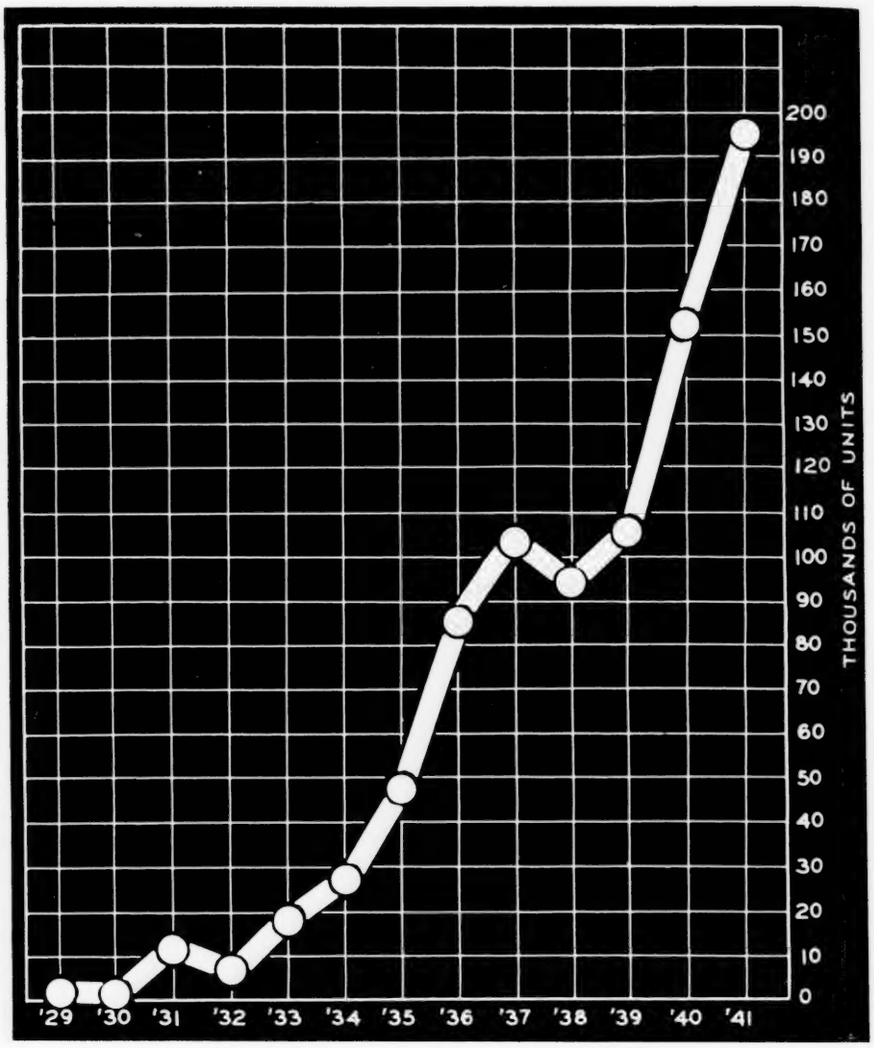
But preceding and shaping the trend to coal is the army of plant executives, engineers and fuel technologists. Theirs will be the job, not new, but of greater significance, of correlating the burning characteristics of coals with the proper equipment. More fuel energy must be converted into useful heat. Fundamentals must be observed more carefully than ever before; for example, high volatile coals require more combustion space than low volatile coals, lower grade coals must be fired at lower combustion rates, and equipment must be selected for successful operation with the coals that are inexpensive and easily available.

Post-War Methods of Burning Coal

As one carry-over of present methods, the small heater, pot stove or furnace, due to low first cost, will apparently always have a market. Repugnant to the engineer because of their utter reliance on the human element, their popularity will continue unchecked.

Handfiring. Continuing as a reliable standby of a whole host of heating plants where anthracite is available, are dumping grates for buckwheat, rice, barley and certain blends. This combination of equipment and fuel will be difficult to improve on for the usual apartment building or commercial loft where the superintendent or janitor is usually the fireman in addition to other duties. Cleanliness with anthracite is a tremendous asset.

Even if savings are possible with other methods, the urge will continue strong in favor of good handfiring. With proper type grates, where the air flow is unimpeded by too much metal, good efficiencies can be maintained with either natural or forced draft operation, but preferably with balanced draft controls. A well designed air flow grate can lower fuel consumption by as much as 25% compared with the pin hole type. The pin hole grate is a requisite when very high static pressures must be carried. Grates with larger air spaces, sometimes in combination with a propeller type fan, because of its diffusing air action under the grates, in conjunction with sensitive pressure controls, make simple and effective combustion systems. Equally important is the low first cost and negligible up-keep expense. No less may be said of the stationary and shaking grate for anthracite or bituminous where income and other considerations may make investment in other methods unfeasible.



Stoker shipments prior to World War II reflected the tremendous demand for automatic coal heat. The sharp rise in stoker shipments was mainly due to increased demand for small heating and steam generating units.

Magazine Feed. The gravity feed, or magazine feed boiler for anthracite pea or buckwheat will also continue popular, but mainly for the reason that it minimizes furnace attention. Gravity feeds coal down to replace the fuel which shrinks to ash in the burning process. The lower the ash content in the coal, the more efficient the operation. The length of the firing period is limited mainly by the capacity of the magazine coal hopper. Since this furnace is contained in the boiler unit, the cost is higher than the conventional boiler. The magazine feed unit should be regarded as a combination stoker and boiler.

Screw-Feed Stoker. The screw-feed stoker, introduced commercially in the early 1920's, was responsible for making coal an automatic fuel at low expense for the great majority of heating plants. Indeed, not only the coal industry but millions of consumers should feel greatly indebted to it, for this method made mechanical firing possible in the vast field of small heating plants formerly tended by hand. Designed from shrewd observation that the most effective burning zone in a stoker is directly above the tuyeres, this device pioneered the complete elimination of side grates. Today numerous manufacturers build, stock and distribute screw-feed stokers so widely that they may normally be obtained with ease to fit every type and size of heating and steam generating boiler wherever coal is used. With new post-war appurtenances of improved coal and ash handling apparatus, they should continue their phenomenal rate of application. The rate of increase in shipments of automatic coal burners in the past decade has been far higher than that of oil burners, while the heating cost with the former is considerably less.

For anthracite, the screw-feed stoker operates well with buckwheat or rice coal; while with bituminous coals, a free caking coal which will

spread out over the tuyeres and dead plate is best. Strong caking coals will form masses of coke, which must be broken down with slice bars or forks. Clinker should be compact, rather than the type which runs freely in the fire and is difficult to remove. Any size up to 2½ in. screenings may be used, but a preferred size is ¼ x ¾ in. Ash content and heat value are of no particular consequence so long as the burning characteristics are favorable and no difficulty with heat or steaming is encountered.

An important feature is the means by which proper mixtures of air and coal are maintained. Just as particular attention is paid to an engine carburetor, so the air regulator is a vital part of the unit. It is important that the air-coal ratio be maintained constant regardless of changing fuel bed conditions and consequent variations in windbox pressures.

The choice of a particular make of stoker should be governed largely by the design and by the organization behind it and its ability to maintain an efficient service in the community.

Retort Stokers. The single and double retort underfeed stoker, feeding coal to the furnace by means of a plunger or ram, will be another carryover into the post-war period. This type of stoker is better able to handle strong coking coals because of the breaking action on the fuel bed by the ram. An efficient stoker will distribute the coal properly over the entire grate surface, bringing into effective operation the maximum burning area, and bringing down the combustion rate. The latter feature is the most important factor governing good operation and boiler output. Many poor grade coals often operate well in amply sized stokers providing low combustion rates while neighboring plants are having considerable difficulty with high grade coals in undersized equipment, necessitating high combustion rates.

Neutralizing Caking. To improve operation with strong caking coals, at least some post-war designs will attempt pre-oxidation of the coal before it reaches the plastic stage. Attempts at breaking the coke formation by mechanical means will also be made. A simple and effective method suggests itself for exploding the coke in the fire by fine water jets arranged in the tuyeres. The sudden generation of small volumes of steam will act to break apart the caking mass and permit proper air distribution. Operation of the jets can be tied in with the coal feed for effective control, on and off periods obviously being required.

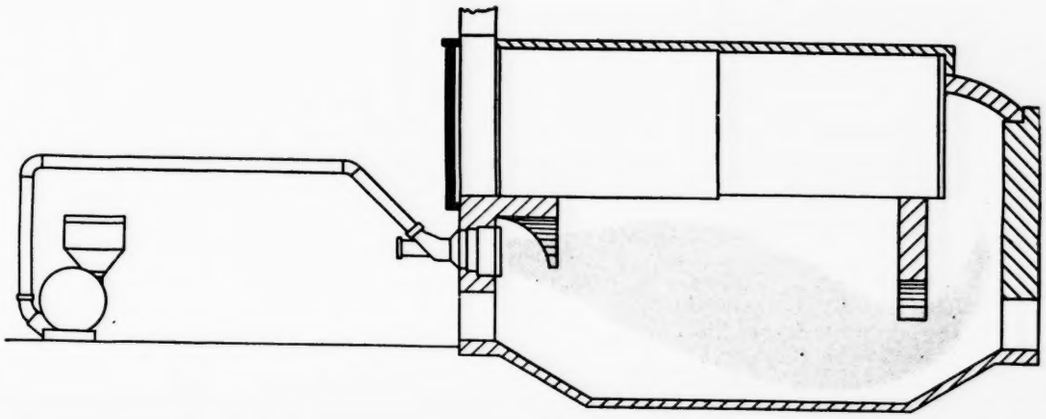
Chain Grate Stokers. The travelling chain grate for bituminous coals has no application to the small heating plant. For larger boilers this stoker offers decided advantages in its ability to handle a wide range of coals with natural or forced draft, and the cheaper sizes may be utilized efficiently. Smoke elimination is easily attained as the fuel is not agitated. Cost of installation, due to expensive furnace design, is usually higher than with underfeed stokers.

For burning small anthracite, the chain grate stoker has no peer. This type stoker, because of its promise in post-war realities, will probably be greatly improved for use in household furnaces and in larger heating plants. Producers and consumers alike of anthracite coal have been neglectful of its good qualities and possibilities. This condition has probably been caused by the great overshadowing publicity enjoyed by the screw-feed stoker types. Originally designed for large boiler furnaces, it has in recent years been adapted to small heating plants with steel firebox and sectional boilers. Geographically limited, anthracite deposits limit this stoker to the east. A combination of clean, smokeless, low cost fuel, plentiful supply and automatic control makes the small chain grate stoker ideal for homes, schools, apartment and office buildings and small industrial plants. New designs are required to fit this stoker to these needs.

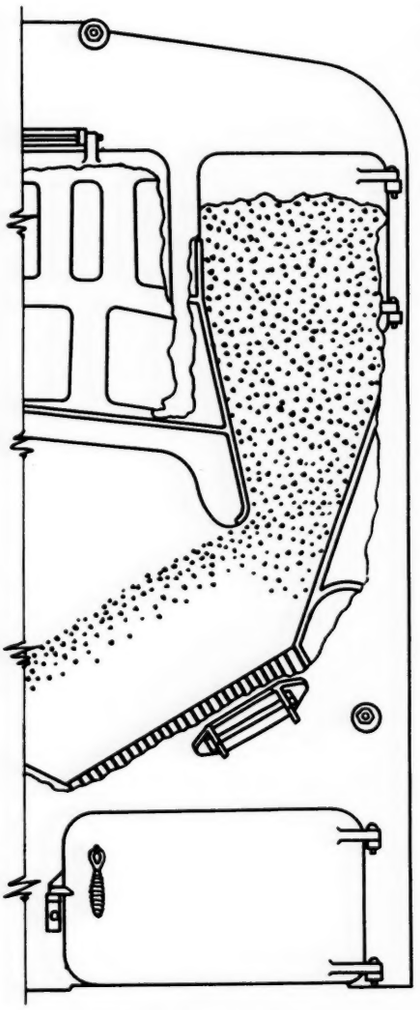
Revolving Grate Stokers. One type of revolving grate stoker, of radical design, features a revolving conical grate, instead of the straight line feed. This unit receives coal directly from the bin; coal then passes through a hollow tube extending to the grate level at the apex of the cone. The fuel, rice or barley, is carried around the furnace while the burning process is completed. A hollow baffle barely scraping the grate retards the ash, which is conveyed by a simple mechanism to the ash receptacle. The opposite wall of the baffle backs up the coal as it feeds from the tube to the grate. The blower, tied in with the coal feed, effects the desired combustion control.

Small Traveling Grates. One of the straight line chain grate models includes a travelling grate so designed that drop-links act as a scraper conveyor on the return travel to the front of the boiler. As the links approach the ashpit, they drop down to bring forward the ash and drop it into a receptacle. On arrival at the front sprocket, they flatten out to form the grates for holding the fuel.

Still another type features a separate and distinct ash conveyor which carries the ash to cans placed either at the rear of boiler or in the front of the stoker. This type is especially desirable for steel firebox and self-contained boiler units. The ash conveyor may be arranged to dispose of the refuse directly at the curb for collection by garbage or sanitation employees. This is accomplished by endless scraper chains operating in flexible tubes extending from basement to curb, and buried below the sidewalk or lawn. The same ash conveying method may be employed with screw-feed stokers and other combustion methods.



Schematic diagram of general arrangement of unit coal pulverizer and boiler.



Gravity or magazine feed anthracite-burning boiler, showing coal storage magazine, inclined grate and self-feeding or stoking feature. Coke as a fuel is also recommended.

Rear-Feed Traveling Grates. Of all the chain grates which are being projected for post-war development, the model which is arousing the greatest speculation and whose details are enveloped in deep mystery, the rear-feed stoker offers splendid solutions to several problems. Three factors seem to have hampered application of chain grate stokers to sectional and steel boilers:—the problem of mechanical ash disposal; awkward location of coal hopper because of obstruction of firing door and free view of the fire; and the cost involved in arranging for mechanical ash removal.

The rear feed model seemingly solves all these problems at one stroke. In addition, it offers coal feed direct from bin to fire. The coal enters the furnace by means of a screw conveyor to rear of stoker. Simply by spilling over on the grate, coal feed is effected without hoppers and without the costly and bulky construction. More important still, the grate moves toward the front of the furnace, not away from it as in present designs. Thus a clear view may always be had of the fire from the standard front door of the boiler. Best of all, the ash is dropped at the front, where it can be hand-shoveled away or mechanically disposed of with the conventional conveyor direct to cans. Stoker drive, coal feed, and ash conveyor lend themselves to easy, convenient and inexpensive arrangement. Primarily designed to utilize the cheapest sizes of anthracite, the unit also burns bituminous coals of free caking types. The greatest demand for this stoker will undoubtedly come from apartment house and office building heating plants, where lack of experienced firemen has called for the use of larger-sized anthracite coals requiring little firing attention. Consequently, comparatively costlier coals were necessitated. The rear feed stoker, automatically maintaining good combustion with plentiful and cheap fuels, seems to solve a great problem with simplicity.

Pulverized Coal. Pulverized coal burners are presently designed for boilers of 13,000 square feet of radiation and upwards. Utilizing bituminous coal in the form of a gas, they are applied to all types of boilers if the flame clearance is at least 10 feet. Post-war design aims at shortening and widening the flame, and a model for house furnaces is under consideration. The efficiency of combustion is very high, while the ash disposal problem is greatly simplified. As most of the ash from the coal leaves the furnace with the products of combustion, dust collectors must be employed. These are composed of static elements arranged in the smoke pipe or breeching which deflect the ash and cause it to collect at a point convenient for removal.

An important advantage of this combustion method is the ability to use an extremely wide range of bituminous coals. The grindability index determines the suitability of the coal, and an index of 100 indicates a coal of very favorable structure, easily reduced to powder. To aid in the pulverization, the coal is heated with preheated air or with gases direct from the furnace. Combustion of powdered coal is rapid and complete. It is interesting to note that while pulverizers require a soft coal of high grindability index, stoker coals should be of hard structure and low grindability, often as low as 25.

A unit pulverizer projected for the house-heating plant combines advantages of gas and oil firing at a fraction of the cost. One design features a self-contained boiler unit, receiving coal directly from the bin, and blowing the powdered fuel through a nozzle in the roof of the furnace. Advantages of this model are maximum flame travel, large furnace volume, increased radiant heat surfaces and reversible gas travel, so effective in separating out the fly ash. Ash is collected in a pocket from which it is flushed to the sewer at occasional intervals.

Spreader Stokers. The spreader stoker holds much promise for post-war development. Its combustion method promotes increased capacity and efficiency at higher combustion rates with most bituminous coals. This is a distinct advantage. All the cheaper sizes of coal may be used and screenings up to 1½ in. are easily handled. The coal is blown into the furnace, the fines burning in suspension and the coarser particles on the grates. Furnaces operating at higher capacities effect a greater degree of pre-oxidation of the coal. This in turn aids increased burning rates per square foot of grate area with a minimum of caking. The fuel thus formed on the grates requires no agitation other than that caused by the forced blast of air from the under-grate blower. The fuel bed rests on a layer of ash, eliminating one of the chief causes of clinkering —mixing of ash and fuel. The air stream carrying the coal to the furnace enters at right angles to the under-grate blast, contributing a high degree of turbulence conducive to good combustion.

The problem of coal handling is minimized by this feeding method as the fuel can be blown to the furnace from long distances or points either below or above the firing room floor. Limited space ceases to control the type of equipment which can be placed in front of a boiler. Only sufficient room for placing the nozzles and tubes need be available.

An important advantage of this method is the ability to use hot air or gas from the furnace for preheating the fuel and the secondary air. Efficiencies may be maintained in the neighborhood of 80% at high capacities. An increase in steam generating capacities of 10% to 35% may be obtained from existing boiler installations with this system.

One type of spreader stoker combining mechanical and pneumatic features has demonstrated marked ability to handle wet coals. The cheapest sizes may be used up to

2 in. Feed screws and coal agitators in the hopper insure continuous feeding. Hopper agitators, incidentally, should be a required feature of all soft coal stokers.

In this stoker the feeding screws are arranged in a row extending the width of the furnace. Under each screw a controlled blast of air blows the coal over the fire, the fines burning in suspension and the larger pieces dropping on the grates. As each feeder is adjustable, desired air-coal ratios may be obtained.

Very little power is required to operate this equipment. The coal is conveyed only a short distance by the feeder screw. The air stream simply blows the coal off a feeding shelf a short distance above the grate level. Consequently small motors and blower are possible.

The important advantages of this equipment are limited space required for installation and ability to step up combustion rates to meet heavier steam demands, in addition to the handling of wet coals. The spreader stoker has enjoyed great popularity in the midwest for some years. Post-war practice will undoubtedly find increasing application of this equipment in the east.

Colloidal Fuels. Colloidal fuels received exaggerated publicity during the oil shortage. It was proposed to supplement the oil supply with a mixture of pulverized coal held in colloidal suspension in heavy fuel oil. In the current emergency along the Atlantic seaboard, advocates pictured colloidal fuel saving large oil gallonage. Expectations have not been justified due to the difficulties with colloidal fuels.

We have an ample supply of coal, under normal conditions, which can be burned with excellent results and few problems. Our method of burning oil have also been developed to a high degree entailing little difficulty. But powdered coal and oil, burning well separately, present many problems when combined. The flame flares out from the burner more than oil alone, carbon masses accumulate on the burner throat, the oil ignition system does not ignite the colloidal fuel, it is not possible to carry the same boiler load as with oil due to the difficulty of supplying enough secondary air in the right spots, the fuel requires a stronger suction if it is to be pumped from underground tanks, the fuel is abrasive and cuts the burner tip, heavy smoke is caused when starting up with a cold furnace, the control valve tends to clog and must be cleared at frequent intervals, and finally the combustion efficiency of coal-in-oil is apt to be less than that of oil. These are the conclusions reported from tests at the Atlantic Refining Company, the Cambria Silk Mills and the National Airoil Burner Company, all in Philadelphia. A sufficiently stable suspension was used of 40% bituminous coal by weight, ground 98% to 99% through a 230 mesh screen. If the coal is not ground to this fineness, difficulty may be encountered from unstable suspensions.

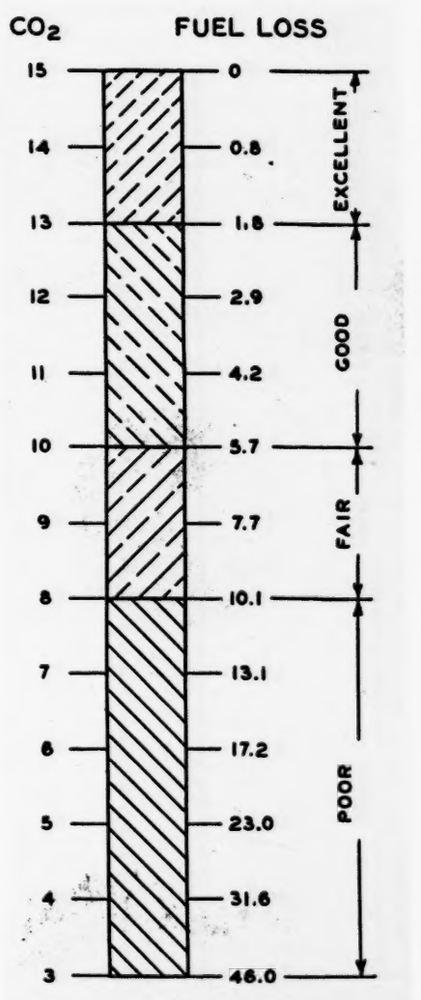
The best opportunity for the successful use of colloidal fuel would appear to be in the larger industrial plants where expert operating personnel is employed. The mixed fuel has some advantage for ships because of the greater heating value on a volume basis as compared with oil or coal alone. A mixture of 45% powdered coal and 55% heavy oil of 18.9 API weighs 10.6 lb per gallon, over 2 lb more than oil alone. The specific gravity is 1.28; the viscosity, 51 seconds at 210F and 277 seconds at 130F, while the weight per cubic foot is 79.29 pounds.

As an emergency measure, such a mixed fuel may be justified, but the preparation of the coal makes the cost equal to or greater than that of oil. Because powdered coal is an excellent fuel by itself at lower cost, the peacetime economy of colloidal fuel for stationary heating or steam generating plants has not been proved and does not appear likely.

Controls

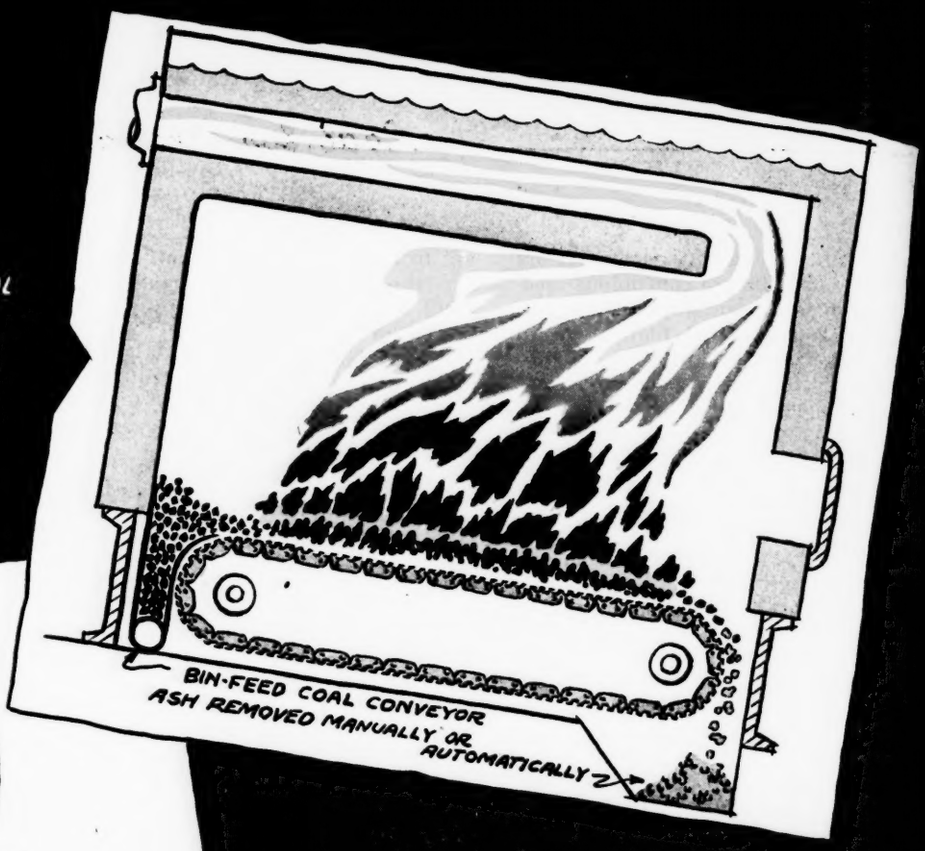
Indications are that post-war design will include recognition of condensate and steam temperatures as desirable starting points for combustion control. A closer tie-in with weather conditions also is indicated. The maintenance of air-fuel ratios through CO_2 variations in the flue gas and through overfire draft changes will merit ever-increasing attention. Combustion control from steam pressure alone or from a combination of pressure and temperature regulation is far from satisfactory. Pressure control methods rested the responsibility for comfortable indoor temperatures entirely on the janitor, superintendent or fireman. The room thermostat was completely at the mercy of the occupant to tamper with it for his individual preference. Door and window openings through carelessness alone might start up the stoker, resulting in unnecessary fuel consumption.

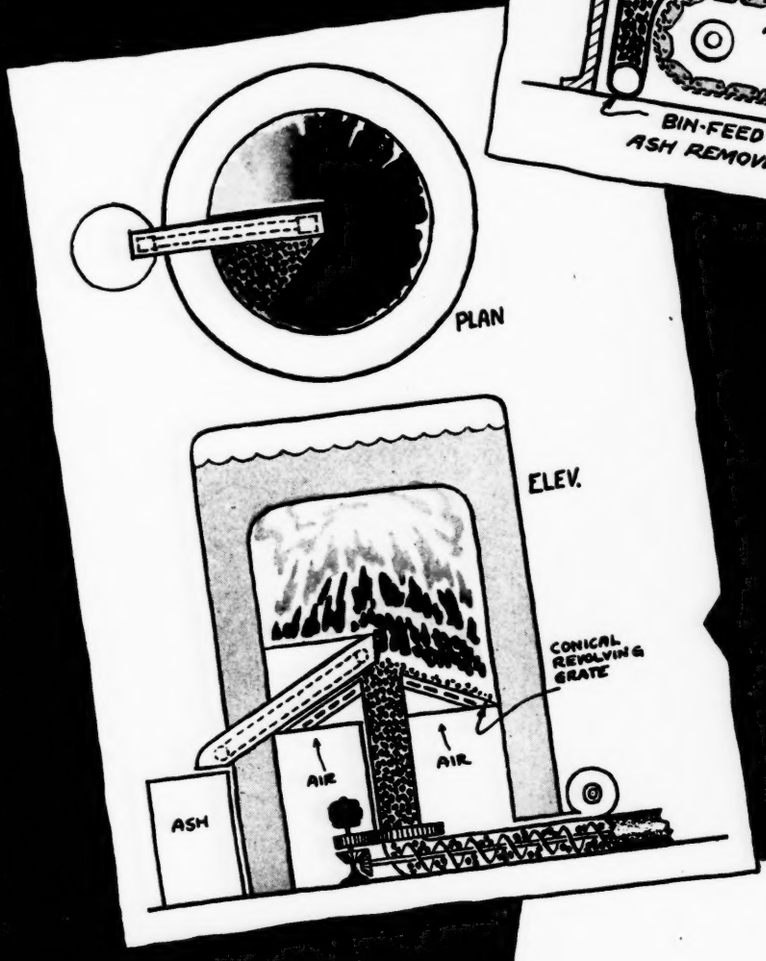
Condensate Temperature Controls. One of several methods would eliminate these haphazard effects by using the temperature of the condensate in the return lines as an indicator of steam-filled heating systems. It is obvious, of course, that so long as the returns continue hot, the radiators are filled with steam. As the radiators cool, the returns will cool also. A thermostat placed on the return line would measure the temperature of the returning condensate. When the temperature dropped to a point which indicated a rapidly cooling heating system, furnace operation would begin. As the returns grew hot, furnace operation would stop, regardless of pressure control and thermostat readings. The fact that the radiators were filled with steam would insure an increase in inside temperatures. In the meantime combustion would cease; deliberate or accidental effects on the thermostat would be



Scale of preventable fuel losses, based on 500F flue gas temperature, pure carbon fuel. Post-war methods should provide for more plants in the upper two zones. (From Hays and Sprague).

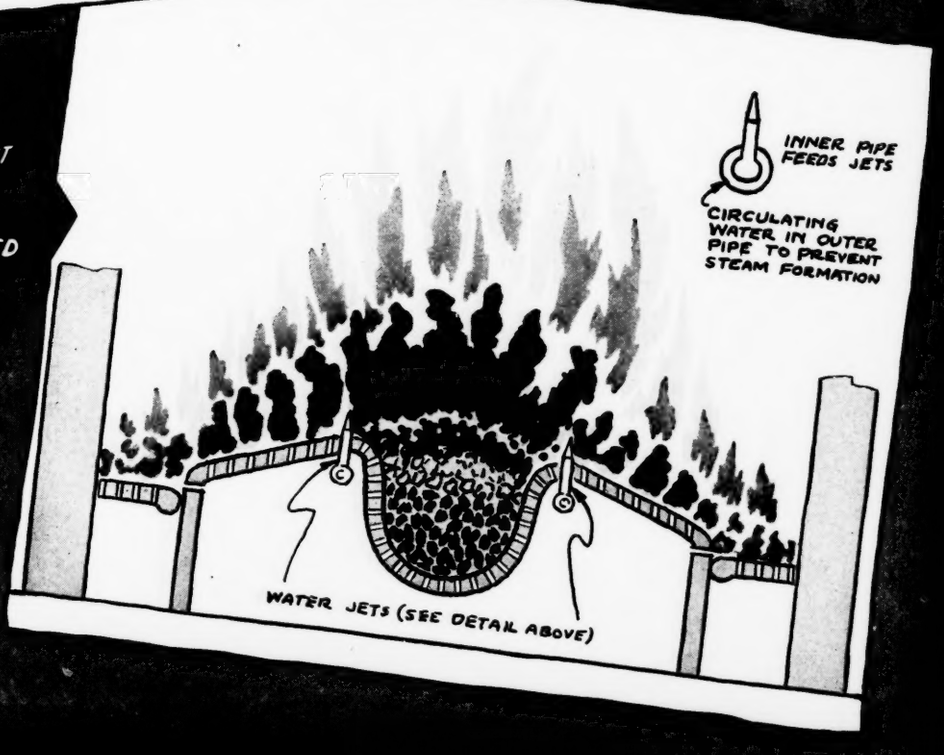
(A) ONE POST-WAR PROPOSAL IS A REAR-FEED CHAIN GRATE STOKER INTENDED FOR SMALL ANTHRACITE OR FREE CAKING BITUMINOUS COALS

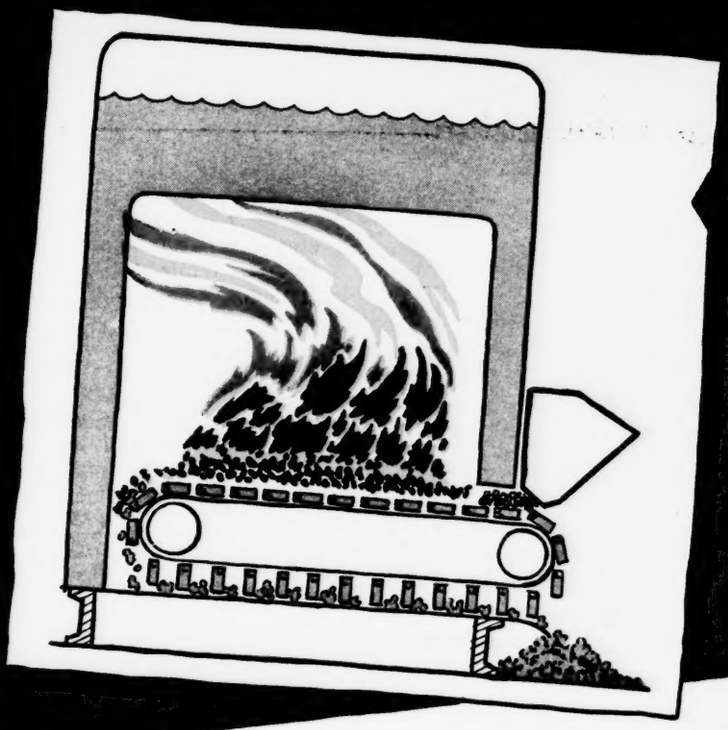




(B) A REVOLVING GRATE STOKER MAY HAVE POSSIBILITIES FOR SMALL HOUSE-HEATING PLANTS BURNING ANTHRACITE

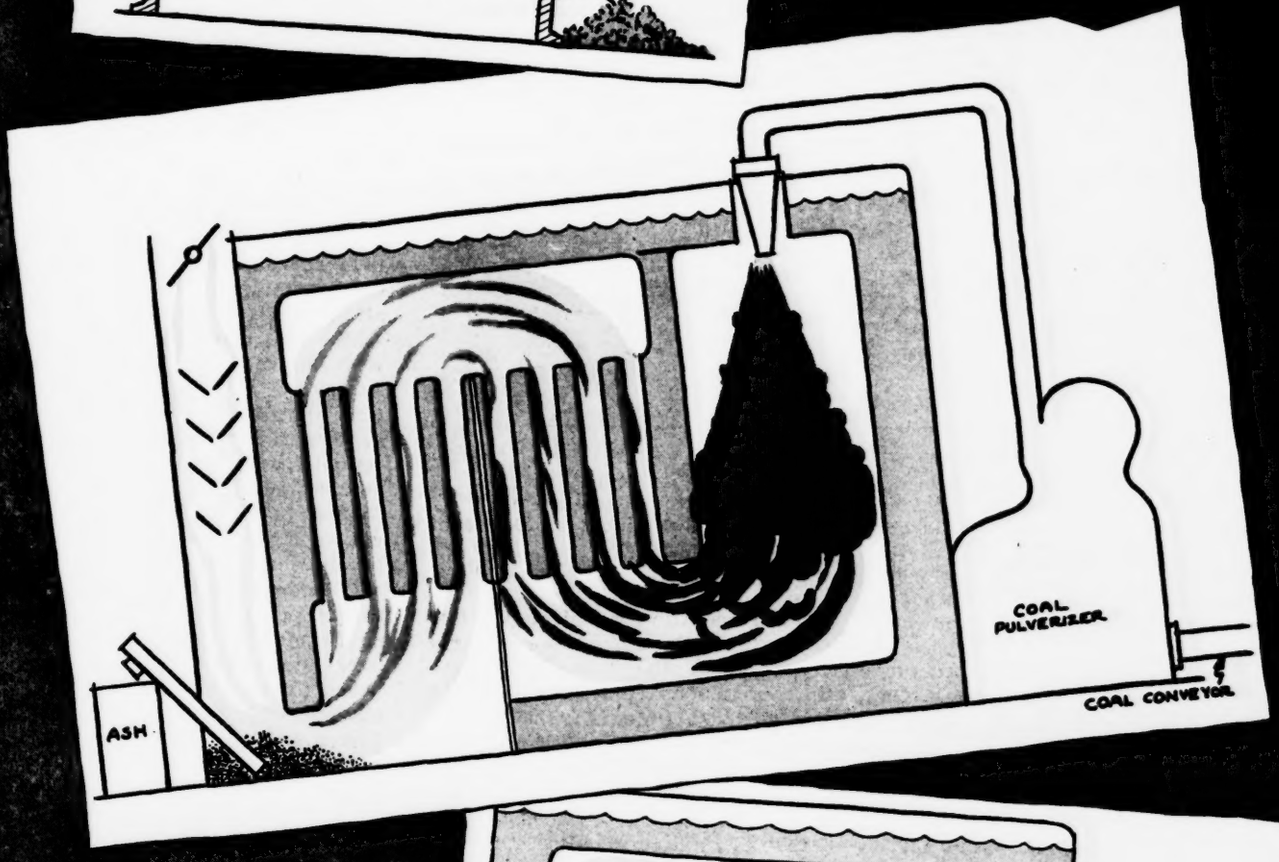
(C) SUGGESTED ARRANGEMENT OF WATER JETS FOR EXPLODING COKE FORMATION IN UNDERFEED STOKER



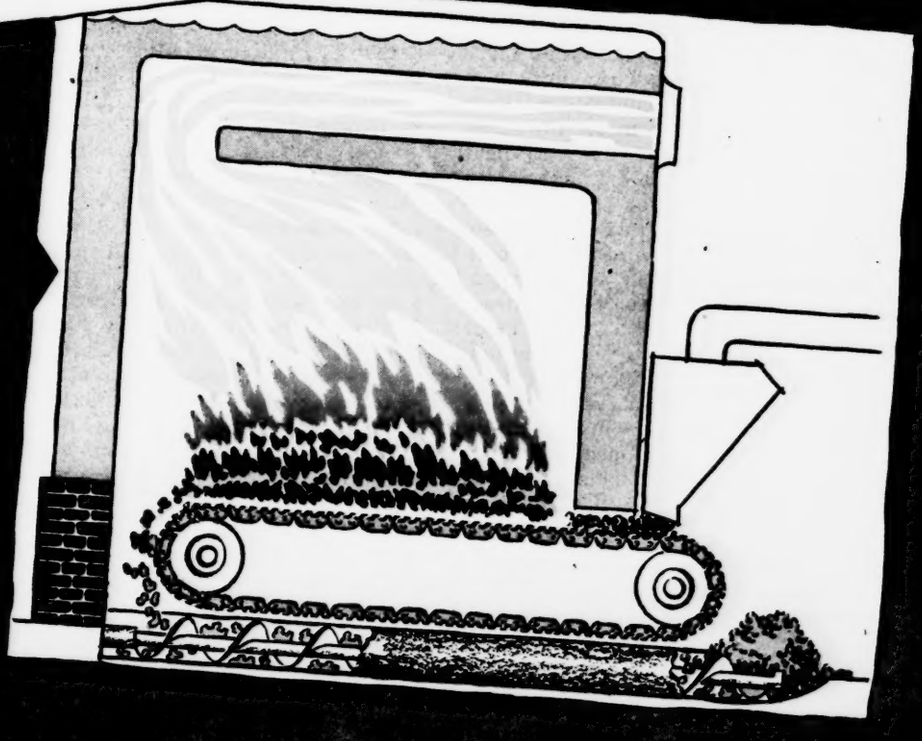


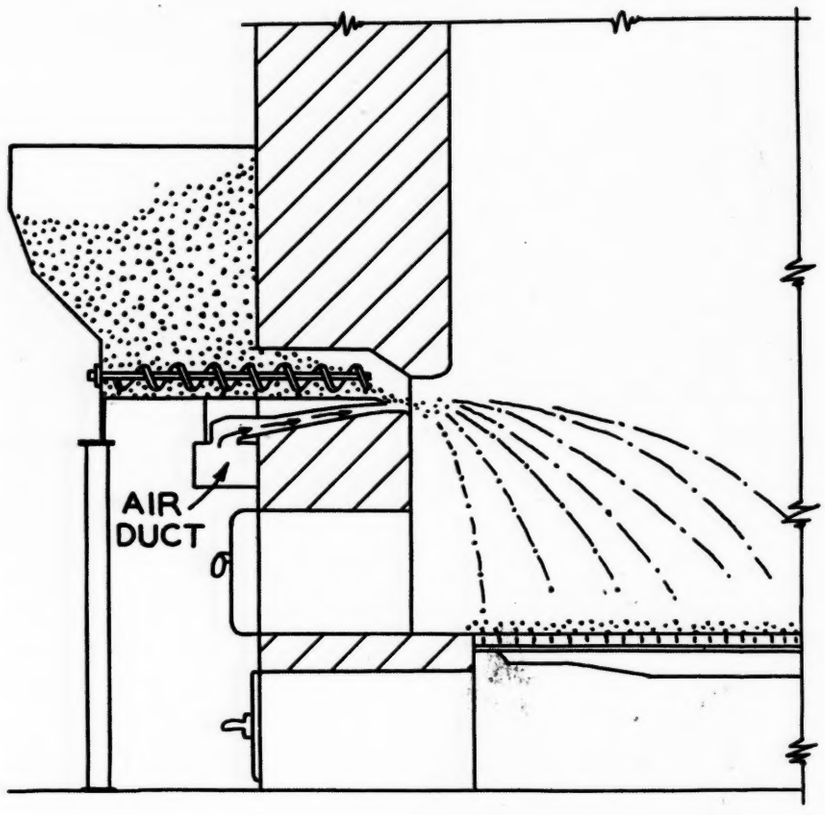
(D) ANOTHER CHAIN GRATE STOKER PROPOSED HAS LINKS WHICH CONVEY THE ASHES TO THE BOILER FRONT

(E) PULVERIZED COAL-BURNING UNIT FOR SMALL STEAM GENERATING PLANTS OR HOUSE-HEATING



(F) ANOTHER POST-WAR IDEA IS A BIN-FEED CHAIN GRATE STOKER WITH A MECHANICAL ASH REMOVER FOR SMALL ANTHRACITE





Natural draft spreader type stoker. Compare with top figure on page 77. This spreader type can handle larger sizes of coal and produces uniform coal distribution over grates.

eliminated, and fuel would be conserved.

Conversely, when steam pressure comes up to the desired point, the burner would stop, sometimes before the returns are hot. In mild weather the thermostat might control operation by remaining "off" when both the pressure control and return line thermostat call for heat. Thus there would be complete coordination among all three control methods working as a unit to meter the exact amount of steam required to heat the building. The intervals between the actuated room or steam instruments on one hand and the condensate indicator on the other are multiplied many times in actual operation. These intervals are a direct measure of the fuel saved. Their effect, it may be seen, is to lengthen the "off" period of burner operation.

It is also clear that success with this method depends on the proper location of the condensate thermostat. While full details may not at this time be divulged, it is obvious that the thermostat should be placed on the return line, if there are several, which heats up last. Otherwise furnace operation would stop before all parts of the system were warm. Furthermore, the temperature settings on the instrument must be determined experimentally in each individual building. Length of return lines, size of building, location of heating plant with respect to risers, degree of building exposure and nature of climate all affect the temperature limits of operation. The results with this method, however, as indicated in a number of experimental installations in buildings owned by a New York City savings bank, have been gratifying.

In conjunction with this method and also independently of it, a thermostat placed in the steam main near the boiler may be substituted for the pressure control. The greater sensitivity of steam temperatures as compared with pressure makes possible closer control over combustion. In one of the plants mentioned above it was found that the building (a small multi-family house) could be heated with a steam temperature of 210F. The significance of this feature should not be overlooked. At 210F the water in the boiler is not steaming. It is merely producing vapor. While this effect is extraordinary in large buildings, it should not be uncommon in residences, one or two story buildings, and taxpayers.

Weather Controls. The effect obtained from condensate-temperature combustion control is also realized with exceptional efficiency through another method. The elimination of local effects on thermostats and of dependence on pressure regulators has led to placing steam supply to a building on the very basis on which heating systems are designed—the weather. With this method combustion is controlled from a weather-actuated thermostat located on the outside of the building. Outdoor temperatures control the length of time the burner shall operate. In colder weather the "on" period is automatically increased while on mild winter days the heating system may be operated for possibly 15 minutes out of every hour. When the outdoor temperature rises above 65F, all heating is stopped and thermostatic hot water control combined with "holdfire" operation take over. In severe weather the heating system approaches constant operation as it nears design temperature. Theoretically, the heating system will be at 100% useful operation at design temperature, the basis on which it was designed by the architect or heating engineer.

Consideration had long been given to the problem of co-relating boiler or furnace operation with the outdoor temperature. This method appears to combine this advantageous feature with that of practicability. The apparatus is of simple design and operates to achieve the desired results. The human element is eliminated in marked degree. In conventional methods inside temperatures lag but with this system weather changes are anticipated as the heating cycle is immediately adjusted to meet variations in outside temperature. The control goes into action to counterbalance the effect before room temperature is affected.

On installation, the regulator is set to the time when furnace operation should begin. Once the building is up to desired temperature, the burner operates only for a fixed period in a time cycle. Heating systems in different parts of the country call for adjusting the regulator to design temperature. A base of 0F would obviously require a shorter operating cycle than one of —10F. The regulator may also be used to operate the furnace a few minutes through each of the night hours as

a substitute for "banking," to run a circulating pump on a hot water heating system periodically through the night to minimize freeze-ups, or to operate a boiler damper to prevent the fire in a hand-operated furnace from going out. It is believed that post-war operation will accord increasing recognition to this versatile method of combustion control, heating regulation and conservation of fuel.

CO_2 Combustion Controller. In the furnace, greater accuracy of air-fuel regulation is possible through constant and automatic coordination with the CO_2 content in the flue gas. Present methods of controlling air supply for combustion are based on coal feed. One of the post-war methods will utilize the conductivity of carbon dioxide gas. The changes in electric current flowing through a wire passed through the flue gas would be used to actuate a secondary air control. This could be arranged to operate a damper in an auxiliary air duct from the main fan or from a smaller blower for this purpose. The secondary air supply would counteract any deficiencies in the air-fuel ratio at any point in the furnace. The air thus supplied would be entirely independent of the fuel-feed.

In small plants, apartments, office and commercial buildings the loss due to unburned gases is probably very great. This method of CO_2 combustion control would make its greatest contributions in plants of these types. Well-trained personnel in expertly-manned boiler rooms may not find as great a need for this system, compared with those now in use.

Firing Signals. A warning signal for blow-holes in handfired or mechanically fed fuel beds is also being developed. The signal would be sounded when burned out spots appeared in the fire, causing in-rush of excess air and consequent lower flue gas temperature. To make the method of operation inexpensive, the expansion and contraction of a wire placed in the smokepipe would be used to measure the temperature changes. The calibration of the instrument would make it adaptable to various types of plants. In addition to attracting the attention of the fireman or operator to the condition of the fire, the signal could also be employed to summon the part-time janitor from his workshop or from other duties when his fire was burning low.

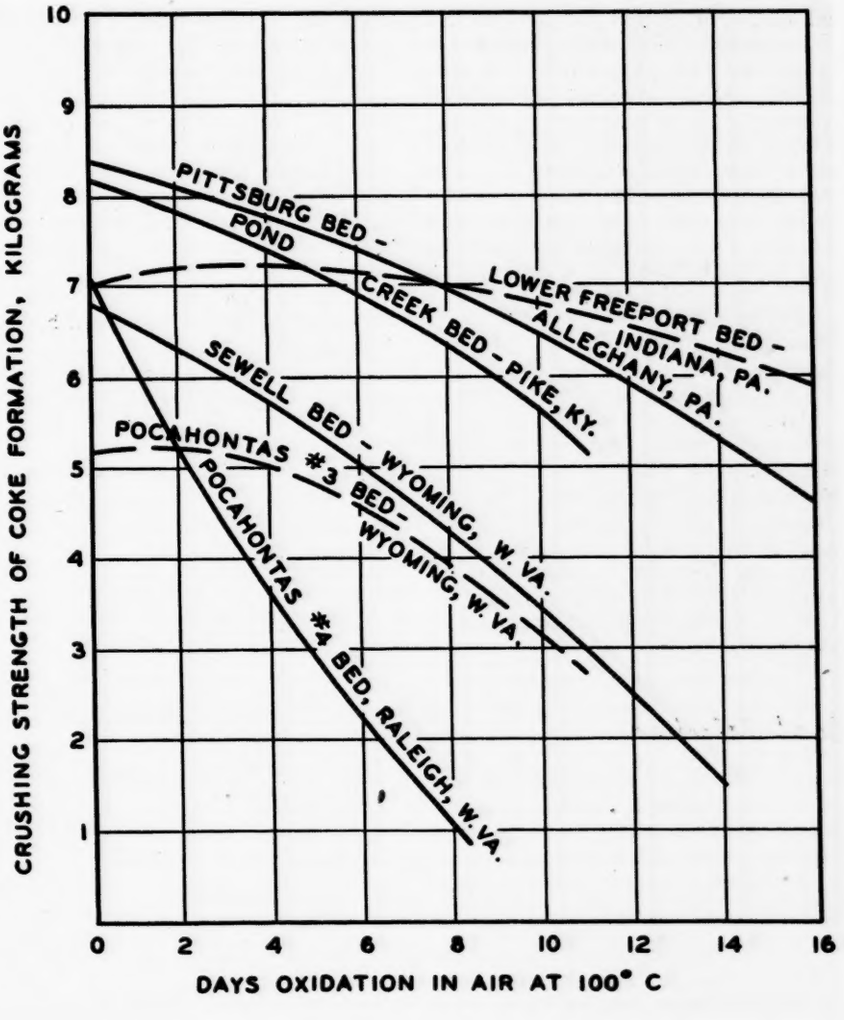
Combustion controls through improved methods or draft regulation now in use and which will continue to find favor in the post-war period are draftostat, barometric damper, pressure-operated damper and induced draft fan.

Draft Controls. A finely balanced barometric draft control sensitive to slight changes in draft can maintain breeching conditions constant despite variations in burning rate and air supply. It is actuated by the difference in furnace and stack drafts, and adjusts them by varying the air intake to the smope pipe in the manner of a check draft. In very hot boiler rooms the damper also acts to exhaust the hot air to the stack.

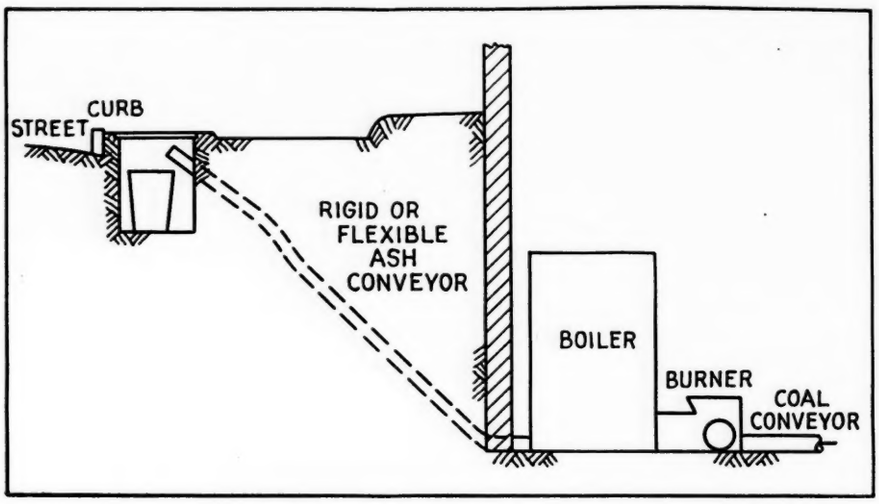
The power operated damper accomplishes the same purpose through positive control. Overfire draft variations are transmitted through a diaphragm to a motor mechanism which varies a damper in the breeching. The action of the damper is graduated, permitting close control. This equipment may also be actuated by rising and falling steam pressure.

Pressure Controls. The oldest form of automatic damper regulation is the positive acting pressure type. With this method the variation in steam demand acts to adjust the smokepipe, breeching or main damper to provide the necessary draft for combustion control. The damper movement may be actuated directly by means of a diaphragm or by a hydraulic piston. The step type is greatly favored over the full open or closed damper.

Another damper of simple design and especially sensitive action can control combustion so closely that steam may be varied in ounces. It operates on the principle of balancing steam pressure with a column of water. The liquid level, rising and falling with changes in steam pressure, transmits the action to a floating vessel. The movement of



Effect of storage of coal on its agglutinating value as determined by accelerated oxidation. Curve from Bureau of Mines data.



Bin-feed mechanical coal burner showing ash-removal-at-curb feature. This is one of the features in the proposed fully automatic stoker.

the vessel is quite pronounced as a variation in ounces of pressure produces a change of several inches in the water level. Stack damper, ash-pit doors, or check damper may all be separately or simultaneously operated by this mechanism. Where steam gauges are not sufficiently sensitive to register pressure in ounces, direct readings may be had on a water column attached to the cylindrical vessel containing the liquid and float. By means of this method, a tight heating system may be kept filled with only a few ounces of steam, so close may combustion be controlled.

Induced Draft Control. Induced draft fans may be used to create artificial overfire draft when long smokepipe travel provides great resistance, where natural draft is insufficient or when it is necessary to eliminate large stacks. The construction is costly as the equipment must handle hot furnace gases. It is especially important to have tight boiler settings where this method is used in order to prevent infiltration of excess air.

Coal Selection

The history of systematic coal selection is almost a blank. A clear process of procedure is open to the buyer of every commodity necessary to the operation of a building or a business, with but one exception, coal. The National Association of Purchasing Agents has shown some progress toward establishing the purchase of coal on something like a scientific basis. Post-war practice will see this type of method developed and carried further.

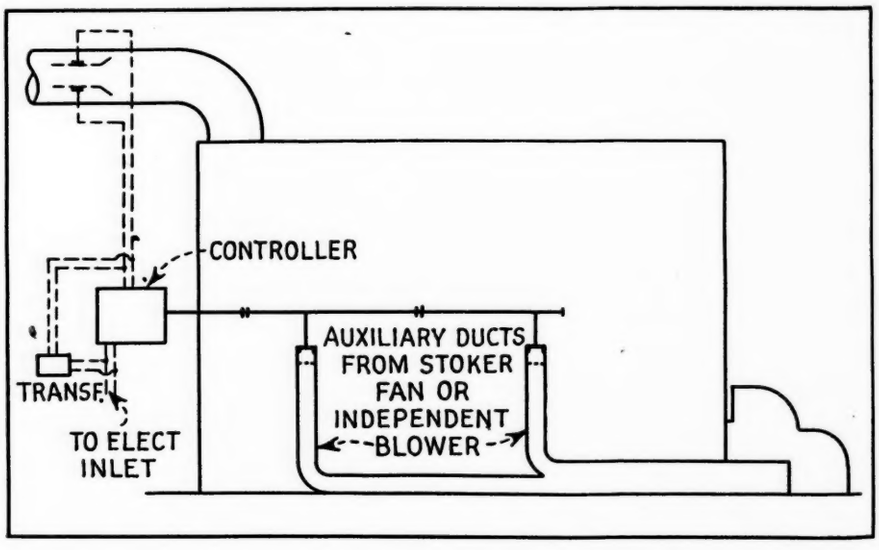
Good results with a coal in a specific plant indicate that for a fixed set of conditions, that coal is good. The degree of success of this coal in another plant is directly proportional to the degree of similarity in the two plants. Having determined all the conditions which are best satisfied by a coal or group of coals, it may then be assumed that under identical conditions in any other plant, those coals are desirable fuels. Thus, a compilation of plant variables may be compared with a list of coals which perform well under those conditions. This is the principle which was used by Roy Emmert in his copyrighted Coalfax method and which appears to be the basis, from available information, of the system being tried by the National Association of Purchasing Agents.

The Coalfax method uses four headings for plant conditions:—Equipment, Load, Operation, Results. Under each heading is a long list of variables covering every conceivable condition. In applying the system to a specific plant, each variable as it applies to that plant, is checked off. The resulting list is compared with coals which are suitable for that list of variables.

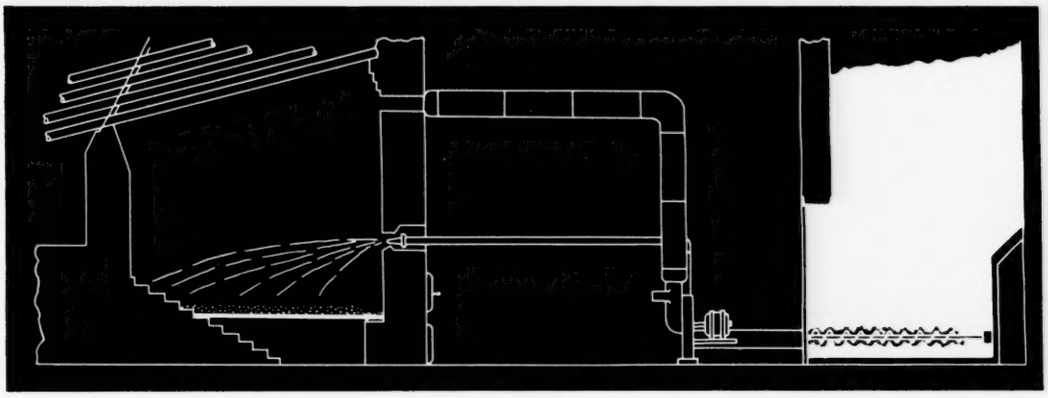
Promotion of this method has been held in abeyance as a result of the present confusion in the coal market. As this method of selection is based purely on history of performance and ignores specifications and analyses as such, a more equitable distribution of coals should follow. Wide application of this system may conceivably bring a large group of coals to the attention of consumers who hitherto made purchases based largely on specifications which those coals did not meet. So-called low grade coals would find a wider market if they had produced good results in any one plant. The higher grade coals would also become available to a larger number of consumers whose plants would be most benefited. In the final analysis, commercial efficiency transcends thermal efficiency.

Choice of Coals

The proper application of coals is measured by the ability of equipment to handle them and by the



Diagrammatic arrangement of CO_2 system controlling combustion by introducing additional secondary air supply. Use of an auxiliary blower for this purpose is preferable.



Sketch showing one type bin-feed spreader stoker with forced draft operation. Compare with figure on page 74.

comparative cost of making steam. By-products of costly prepared sizes are cheap and it was for the purpose of their economic utilization that mechanical stoking methods were devised. The objective of making coal a comfortable fuel to handle was a secondary one, although of at least equal importance from the viewpoint of certain types of customers.

Adaptability to mechanical firing is indicated by coal characteristics generalized in the following, where (A) indicates kinds of coal, (B) their ash fusion temperature, and (C) size of coal:

I. For screw-feed deadplate stokers:
- (A) Free-burning, non-caking bituminous coals because of non-agitation in uniform feeding rate; anthracite No. 1 buckwheat or rice coal;
- (B) High ash fusion temperature due to high burning rate necessitated by limited zone of air admission to fire;
- (C) Screened or unscreened sizes up to 2 in.; preferred sizes are ¼ in. x ¾ in. and ⅜ in. x 1¼ in.

II. For screw-feed stokers with side grates:
- (A) Free-burning, non-caking bituminous; anthracite rice; blends of rice with bituminous or of rice and barley with bituminous;
- (B) High, medium and low fusion, the last possible only with very low combustion rates;
- (C) Screened and unscreened sizes up to 2 in.; preferred sizes are ¼ in. x ¾ in. and ⅜ in. x 1¼ in.

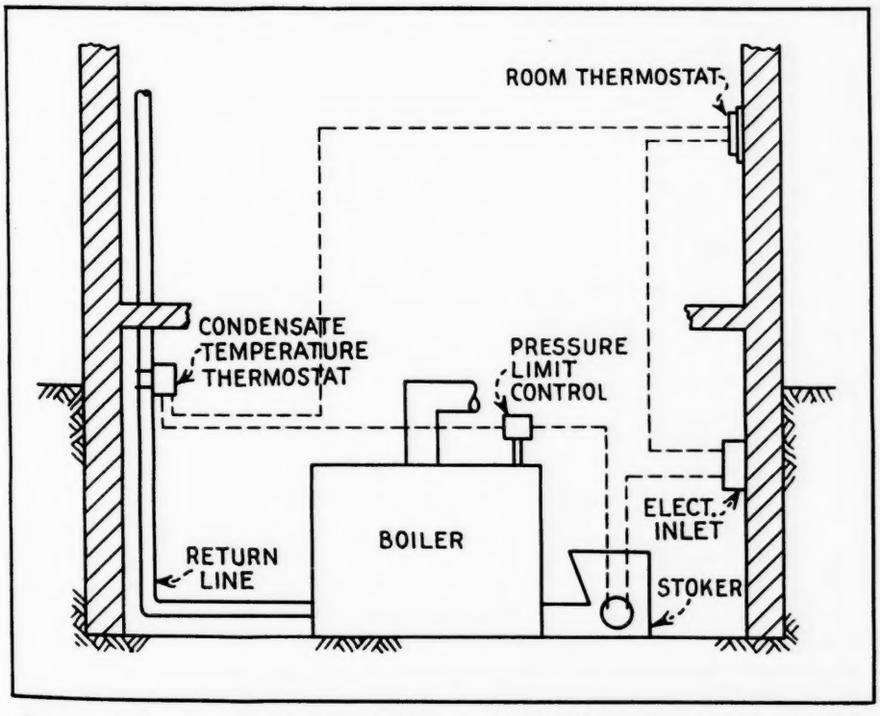
III. For single and double retort underfeed stokers:
- (A) Free-burning, caking and non-caking bituminous;
- (B) High, medium and low fusion coals.
- (C) Screened and unscreened sizes up to 3 in.; preferred sizes are 2½ in. resultant, ¾ in. x 1½ in., ¼ in. x ¾ in.

IV. For chain grate or travelling grate stokers:
- (A) Free-burning, non-caking bituminous; anthracite rice or barley, also No. 4 and No. 5 buckwheat; lignites;
- (B) High, medium and low fusion coals;
- (C) Unscreened sizes up to 2 in.; preferred sizes are 1¼ in. and under.

V. For spreader stokers:
- (A) All grades of bituminous coal;
- (B) High, medium and low fusion;
- (C) Unscreened sizes up to 2 in.; preferred sizes are 1½ in. and under.

VI. For pulverized coal burners:
- (A) Free-burning, caking and non-caking bituminous coals of soft structure and high grindability;
- (B) High, medium, low and very low fusion;
- (C) Unscreened sizes, slack and dust.

Coal for bituminous screw-feed stokers should be treated to allay dust and prevent freezing. Oil-treated coal is cleaner to handle and burns better than untreated coal. It also does not permit absorption of water. Calcium chloride in solution sprayed on coal is also a good method for dust treatment, as the calcium chloride attracts moisture and uses this property to attain its objective. Various commercial compounds for making coal dustless, preventing freezing and improving combustion are on the market. One or two have merit; the others, claims.



One method of coordinated combustion control, with condensate thermostat, room thermostat and limit control in series. The purely diagrammatic layout shows principle of operation.

Smoke Abatement

The interests of public health, civic beauty and fuel economy predicate a clean atmosphere. While it is true that post-war coal-burning

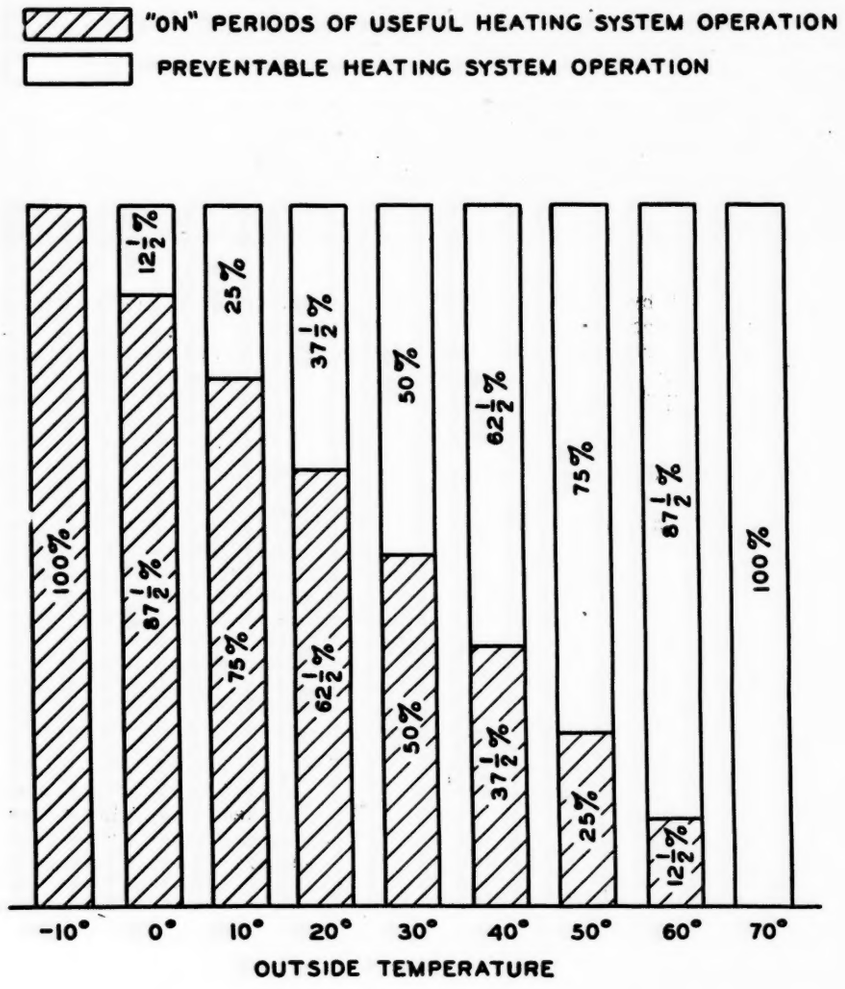


Chart showing "on" and preventable times of heating system operation at various outside temperatures, based on design temperature of —10F.

methods will materially aid in the abatement of the smoke nuisance, a further program of education and helpful service to coal consumers must be pushed.

The cause of smoke production is clear enough. As a convenient illustration of the principle involved, the log fireplace in the home living room provides an interesting study. Some of the area in the fireplace is clean while the rest is smoke blackened. The clear patches will be found near the high temperature zones where ample air is available for the combustible gases released from the burning logs. Where a combination of lower temperatures and insufficient air failed to completely burn the gases, as near the upper walls and roof of the fireplace, soot was deposited.

The same process causes smoke in the boiler furnace.

Smoke Abatement Methods. Steps to be taken for the abatement of the smoke nuisance are: first, prevention by proper design of furnace and coal-burning equipment, good operation with coal selected to fit the burning method or use of a fuel which produces little or no smoke; and second, removal of the carbon particles from the flue gases after smoke has been formed.

Recent improvements in the application of overfire air and steam jets promise more effective control of smoke formation in the boiler furnace. These jets are applicable to stoker operation or hand firing. Proper combustion of jet design, spacing, and intelligent operation result in higher efficiency and smoke abatement. Jet operation can be varied to supply secondary air with turbulence, or to promote turbulence aione without the addition of air.

Carbon particles may be removed from smoke by washing and by electrical precipitation. In the former the smoke is passed through a spray of water while in the latter, the gases are passed between highly charged electrodes.

Smoke is a colloidal dispersion of a solid in a gas. It consists mainly of particles of unburned carbon. These particles acquire electric charges due to friction in flow. Some carry positive and others negative charges. As they move between highly charged electrodes, or plates and wires, they are attracted to the oppositely charged surfaces. The dispersed particles, now free of electrical charges, collect into larger particles and are precipitated.

Any study of smoke abatement methods must keep one fact in the forefront, like a beacon light, to guide progress in the desired direction—*a flame is produced only by the burning of gas.* When any solid fuel burns with a flame, it means that the solid is releasing or producing gas. Air must be mixed with this gas so it will burn completely. Of the solid fuels, coke has the least amount of volatile. It therefore burns with less flame and, consequently, with less smoke than any

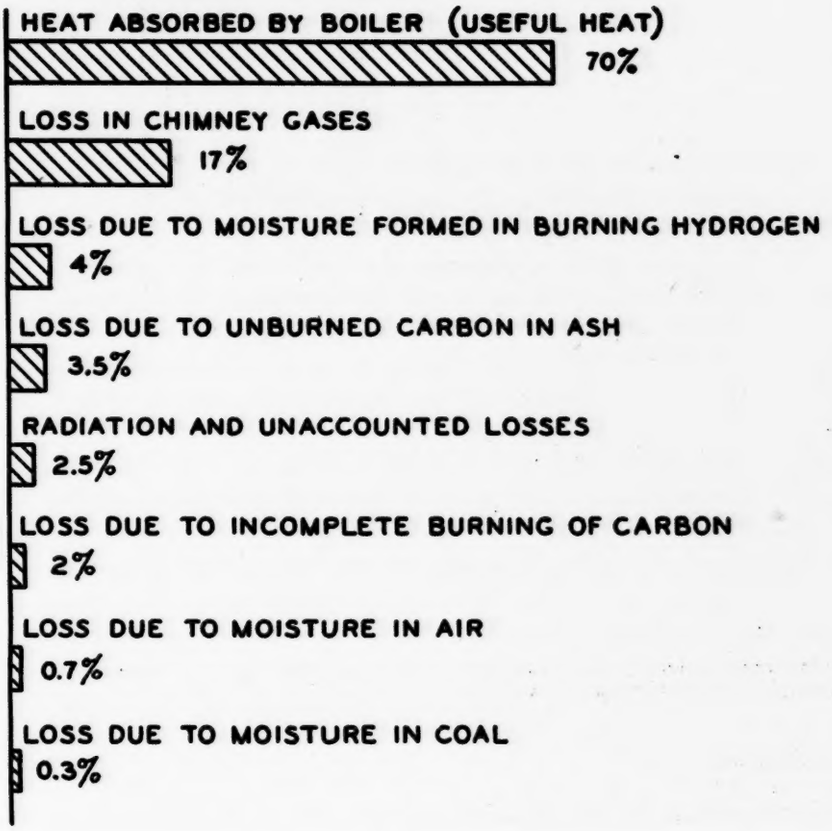
COMPARATIVE COST OF FUEL ON EQUIVALENT OUTPUT BASIS WHEN ANTHRACITE COSTS $10 PER TON

Anthracite, per Ton 13,000 Btu's per Lb		Bituminous, per Ton 14,500 Btu's per Lb		Heavy Oil per Gal. 148,000 Btu per Gal. Eff. 75%	Manuf'd Gas per 1000 Cu. Ft. 550 Btu per Cu. Ft. Eff. 80%	Natural Gas per 1000 Cu. Ft. 1000 Btu per Cu. Ft. Eff. 80%
Hand Fired, Eff. 58%	Mech. Fired, Eff. 75%	Hand Fired, Eff. 55%	Mech. Fired, Eff. 75%			
$10.00	$7.65	$9.40	$7.00	6.3c	29.4c	52.7c

other solid fuel. As the amount of volatile increases in various coals, such as anthracite, semi-bituminous, medium volatile and gas coals, the difficulty of obtaining intimate mixtures of gas and air increases progressively. This is true not only because of the larger volume of gas released, but of the need for introducing the air where most needed. This becomes clearer when it is realized that complete burning of coal takes place in three steps.

First, the coal in the bottom of the fuel bed burns in an ample supply of oxygen to form carbon dioxide; second, the carbon dioxide thus generated passes through the incandescent zone of the fire and is reduced to carbon monoxide; and third, when sufficient air is available in the furnace space above the fuel bed, the carbon monoxide and other volatile gases burn to carbon dioxide. The burning process in the furnace above the fuel bed will continue as long as there is sufficient air and until the gases are cooled below the ignition temperature.

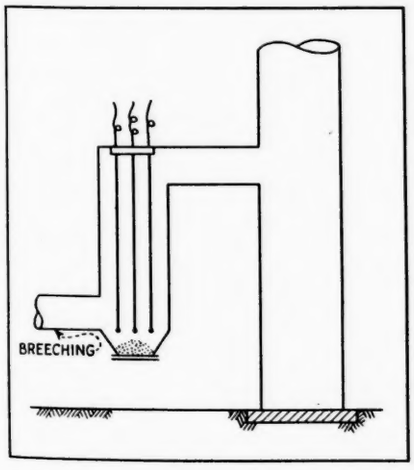
We must therefore have a combination of sufficient air and ample space in the furnace for best results. This requirement is greatly minimized in the case of coke and anthracite coal, due to their low volatile content.



Typical heat balance, showing distribution of heat losses in a boiler furnace. Heat loss through stack is a major item.

Central Heating Plants

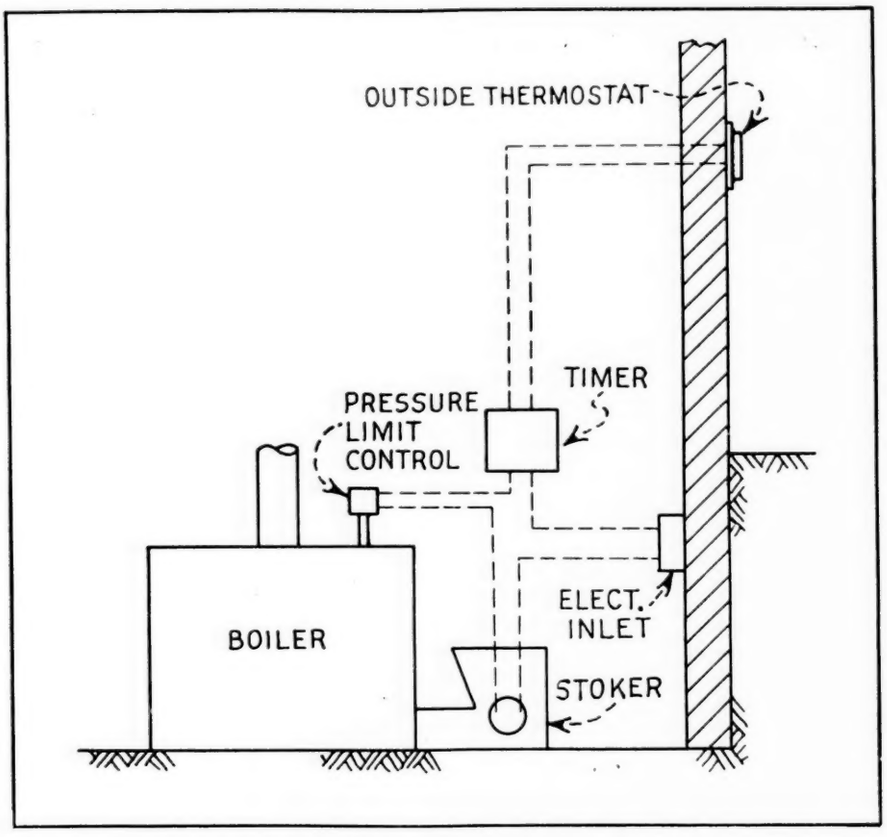
The home owner's idea of Utopia is almost attained by piped steam for residential communities. Steam in mains tunnelled under village streets, reduced in pressure and measured through a valve thermostatically controlled, to maintain any desired house temperature, is a sufficiently attractive picture to encourage post-war planning in this direction. Proponents of this plan hold out a prospect where the householder does nothing except pay his heating bills. Reduced heating costs combined with freedom from furnace chores are entirely practicable where the central plant generates electric current in addition to supplying steam.



Schematic diagram showing method of electrical precipitation of carbon particles in smoke. Smoke-laden flue gas enters breeching, passes between electrodes, and carbon particles are precipitated.

Suburban housing developments could well include a central plant to be owned and operated by the residents. The problem of franchises now held by public and private utilities would have to be worked out where streets are crossed. The question might arise whether the cost of service by the community plant would represent a large enough saving, after taking into consideration the assessment per house (as represented in the sales price), to be a definite advantage. There is also the probability that a large collective headache might supersede the separate one of the house plant. Towns and villages far removed from the larger cities would be the first to benefit from central community plants, especially those at great distances from coal producing regions. In highly concentrated urban areas street steam has been the basis of profitable industry for some time.

Large buildings with rentable basements, such as banks with safety deposit vaults, may find the cost of piped steam no higher than with private plants. The space formerly occupied, or otherwise intended, for the installation of boilers may be credited against the cost of purchased steam when it is turned to income-producing purposes. Another method of lowering purchased steam costs is the renting of existing boilers in the building to the company supplying the steam. Generally, however, the cost of purchased steam from central heating plants in large cities is sufficiently higher to warrant operation of his own plant by the building owner.



Arrangement whereby combustion is partially controlled by outside weather; rising outdoor thermostat is connected through timer with stoker motor.

Conclusion

Standing out in the current situation is the important contribution to meeting the coal shortage made by blends composed of the most plentiful sizes of anthracite and bituminous. Originally intended during the past decade for economic utilization of coals not separately adapted to standard combustion methods, their combination through proper matching of burning characteristics produced a fuel far superior to either constituent. The spotlight of achievement thus thrown on blended fuels for handfiring heating plants is sure to spur further development in the post-war period.

A further project for research lies in finding out more about how a coal pulverizer does its job. Combustion of powdered coal is closest to the ideal method—transforming solid fuel into gas. Although much has been written on the results obtained by the use of various types of pulverizers, less has been said about what makes them work or what principles are involved in their operation. The problem is best stated in the words of the consulting engineer, J. K. Blum, who said that pulverizing can be considered as a competitive test—sometimes the machine is the winner and the material is pulverized; at other times the material is the winner and the machine is pulverized.

The post-war period will undoubtedly witness redoubled efforts in the underground gasification of coal. Tests have been made in at least two Russian collieries. First suggested by the Russian chemist Mendeleeff in 1888, the proposal of underground gasification was revived by the British chemist, Sir William Ramsey, in 1912, when he suggested use of the method if a then current coal strike continued. The object was to minimize the labor of mining. The Russians started active experimentation in 1917, but news of the results has been fragmentary. Two methods were employed: the "stream" method and the "warehouse" method. In the first, two shafts are sunk and connected by a gallery at the bottom. After a fire is ignited, air is forced down one shaft and gas taken from the other. In the experimental station in the Donbas, gas was produced without interruption for 18 months. The product varied greatly in composition and calorific value. Most of the output ranged from 85 to 220 Btu per cubic foot.

The second method involves preliminary underground mining in which chambers in the coal bed are filled with crushed coal. The making of producer gas by burning the coal with an insufficient supply of oxygen follows. Water gas was also produced by alternating the air blows with steam.

There has been much talk but little action on a national policy of requiring that neither fuel oil nor natural gas be used where coal can serve equally well. Production of gasoline from natural gas is particularly attractive because of the low cost of the gas and manufacturing process. The programs of research of the anthracite and bituminous industries are in accord with such a national policy and are following the line of development of processes and equipment with which coal can fill the need for clean, convenient, and controllable low-cost heating and steam generation.

This proposed national policy can be effectively inaugurated at once by making permanent the large scale conversions from oil to coal and by requiring that converted plants wishing to return to oil in the post-war period must show why coal should not be continued. Problems of efficiency, convenience and labor can be solved. Solutions are in evidence every day in practically all sections of the country. Courage and a strong hand on the tiller are not lacking in that quarter where national policies are originated. Consequently, we need not fear that strong gusts of adverse opinion will upset the craft when a firm course is eventually charted.

Whether the new methods discussed here for utilization of coal, combustion, and controls will be put to practical use in the post-war world is a matter which may be likened to Faraday's reply to Gladstone. When the great prime minister asked whether the then newly discovered electricity would ever be put to practical use, Faraday replied, "Why, sir, there is every probability that you will soon be able to tax it."

Some Notes on Radiant Heating

T. W. REYNOLDS

AMONG the numerous articles which have appeared on radiant heating the writer has yet to read anything about the size of boiler required with such form of heating. For example, if there is no distribution system of any moment, then there is no pick-up of any moment to add to boiler size. Is there a definite answer, then, to the question "Does a radiant heat installation require the same size boiler as a convection system?"

Most contradictory and uncertain material has been printed regarding the ground floor loss of floor-type radiant heating systems. What pick-up does this add to the required boiler size? Probably none, as a system once heated up in the start of the heating season before ground cooling has gotten underway would become more or less stabilized as to temperature. On the other hand, any piping run along northerly exposed walls may have a substantial ground loss, as the writer once found out to his sorrow in the case of long underfloor warm air ducts in an industrial heating and cooling system.

In the case in mind, those ducts along both southerly and northerly walls gave a decided drop to the temperature of air emitted at grilles near the end of duct runs and this condition continued for a long time. The air temperatures at grilles along the southerly wall did improve in time; however, the air from the more distant grilles along the northerly wall remained at least five degrees cooler than at the beginning of the run. To improve this situation it was necessary to circulate considerably more air through the northerly duct to the extent that the near grilles had to be almost completely closed to prevent too much air at duct outlets near the beginning of a run. Avoidance of one situation brought on a second situation almost as bad as the first.

One case of a floor radiant heating system comes to mind where radiant heating proved a decided advantage after a forced warm air system had failed to produce satisfaction among the workers. This was in an aircraft hangar where large doors are opened frequently for short intervals and which when closed stopped the breeze, but left behind an enormous volume of cold air which the fan system was too slow in recirculating and warming up again. The radiant heating system gave some comfort when the doors were open and instantaneous and full comfort when the doors were closed. Obviously, radiant heating systems would seem to be the answer in the case of aircraft hangars.

In industrial establishments radiant heating systems may also have their advantages for there is so much of usable floor and so many hot processes and other factors causing air movement throughout, that floor systems may be the answer, if so located and arranged that heavy machinery may be occasionally shifted without too much interference with the floor system. On the other hand, one may wonder where he can find a place to install a radiant heating system in the home of tomorrow which will be largely of glass, according to some, yet can't be and find room for the numerous items of built-in furniture and closets (a closet for every purpose) according to others. Further, the decorators are going to cover that floor with some very heavy rugs, or at least that is their ambition. Somewhere a co-ordinator is needed. Of course, the glass will have to be double or triple, or there will be too much cold surface to absorb radiation from the body.

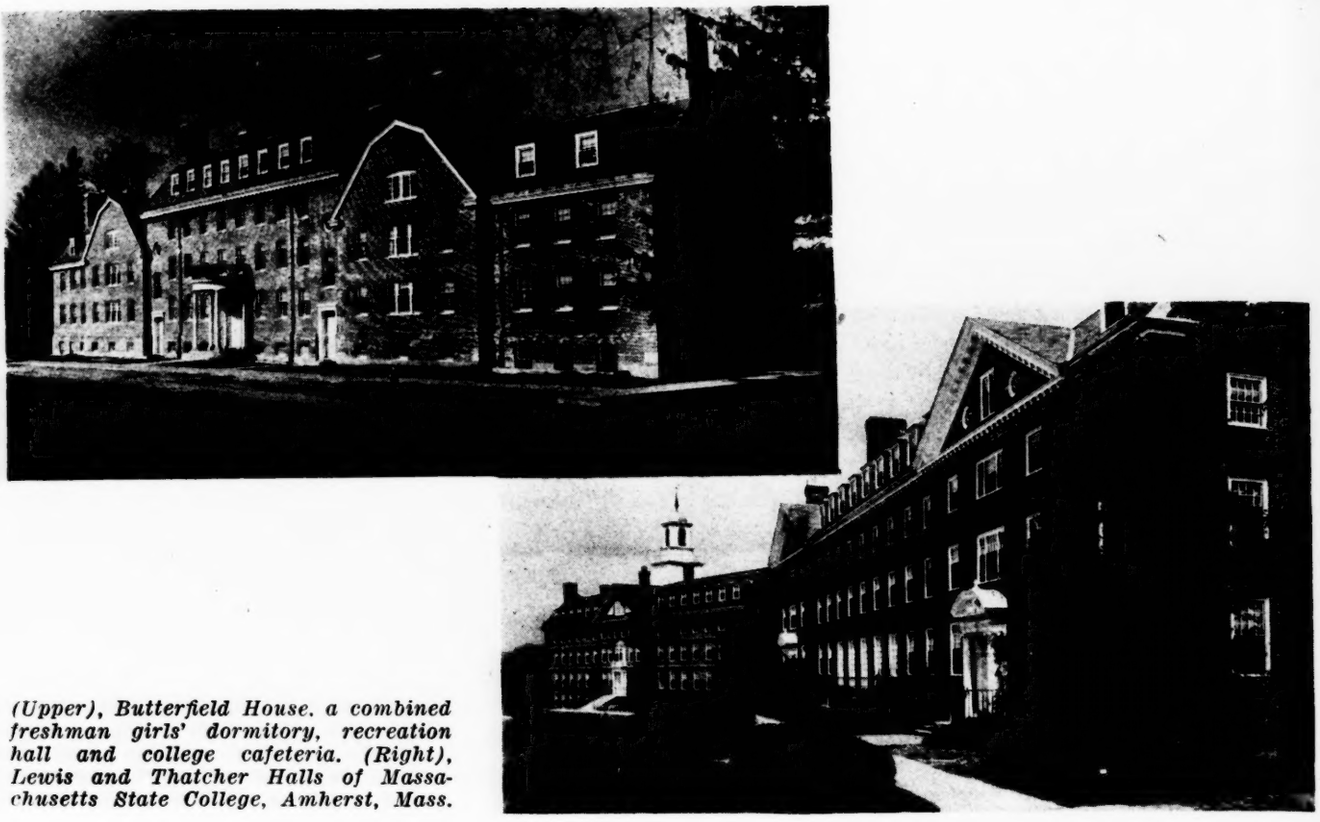
To what temperature will the spaces heated by radiant heating be heated? Theoretically it can be low, but in all of the writer's observations so far he finds in actual practice the same space temperatures used as before and with radiant heating calculations checked by the old heat loss method. Finally, the capacity of heating actually installed is made the equivalent of what we have always computed in the past.

Weather Observers Have Difficulties

Few weather observers have to work under the conditions faced by the staff of the Mt. Washington, N. H., Weather Observatory. The station is atop the 6,300-foot mountain, and rarely do the men enjoy a full day of sunshine.

Wind velocity has reached 231 miles an hour, and a temperature of —50F has been recorded. On the average, 67 out of 100 days are cloudy, 13 clear, and the rest of the time the summit is encased in a blanket of fog. It is only once in every five days that the station may escape fog, and on that day, it may be cloudy.

Sunlamps are provided for the staff to bolster their general physical condition.



(Upper), Butterfield House, a combined freshman girls' dormitory, recreation hall and college cafeteria. (Right), Lewis and Thatcher Halls of Massachusetts State College, Amherst, Mass.

Central Plant Heats 45 Buildings

F. N. HOLLINGSWORTH

FORTY-FIVE buildings of the Massachusetts State College at Amherst, Mass., are served by a central heating plant. This college, on the opposite side of the town from Amherst College, has over 1,700 students.

The Heating Plant

Steam for heating and some process purposes is supplied by three Heine Boiler Company boilers, rated at over 1,500 hp. They are fired by three Combustion Engineering, Type E stokers, with enclosed vertical type of coal conveyor, which brings the 1½ to 2 in. size fuel from a pit and dumps it into the hoppers. Stokers have Minneapolis-Honeywell controls, and are from the Perfection Grate & Stoker Company, Springfield, Mass.

The three boilers, each 22 years old, have a rated capacity of 39,000 lb steam per hour, at a working pressure of 200 lb, but are capable of supplying 52,000 lb per hour, even though their present efficiency is figured by the plant engineer at only 75-80%. Average annual production of steam is around 18,000,000 lb, for both heating and process work. The boiler plant is situated in a hollow beside a little brook, and slightly below grade of practically all the buildings so that the condensate returns by gravity.

A separate heating plant was established in 1941 for two new buildings, Butterfield House, a girls' dormitory, recreation building and cafeteria, and Fisher Laboratory. This latter plant was geared to use 51,000 gallons oil annually. A separate plant was built because the cost of 1600 feet of additional tunnel and piping was prohibitive. However, due to the shortage of oil, the college was forced to convert this plant to coal. Steam from this small plant, which includes an H. B. Smith boiler and a small Kohlmaster worm-feed stoker, not only heats the two buildings but also supplies process steam for the cafeteria of Butterfield House, and for sterilizers and stills in the Fisher laboratory. The stoker has to be hand filled from the outdoor coal bin, as the basement of the building is too small to hold a sufficient coal supply.

Up to 1943, the main boiler plant has also supplied steam power for three electric generating units with a total annual capacity of around 2,000,000 kilowatt hours. However, electric power is now obtained from the local town plant. All buildings, as well as the dairy barns and poultry houses, horti-

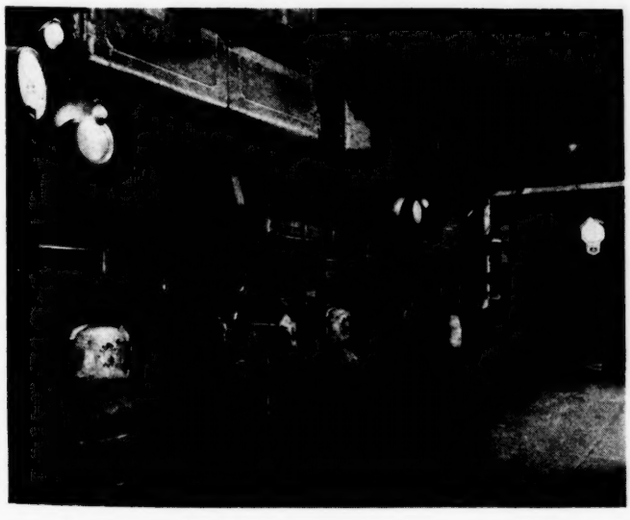
culture buildings and greenhouses are heated from the main underground lines, which total some 35,000 feet of mains and returns, including 9,400 feet of tunnels, 15,600 feet of conduit lines and 3,400 feet of branch lines and returns. They serve an area of about one-fourth square mile, although the campus itself covers about 700 acres. The dairy barns, poultry buildings and others housing stock are heated by steam coils and radiators, but some of the buildings, including the handsome Goodell Library, Fisher Laboratory, Thatcher Dormitory and the Physical Education Building, are equipped with Herman Nelson units of various types and sizes. A considerable amount of steam is used in greenhouse heating.

Tunnels Supersede Conduits

The new steam tunnel exits from an upper floor of the boiler house on a steel bridge over the brook, and enters the ground on the opposite bank. Boilers are fed with makeup water from the town supply by a Worthington feed pump and a Warren reciprocating outside plunger type pump.

Fuel Consumption

Federal No. 1 coal showing 14,000 Btu per pound of fuel is used. About 8,000 tons are used annually. Figures for 1941, the latest available, show an annual consumption of 8,102 tons coal and 172,421,096 lb water. Total degree days recorded in 1941 were 5455.4. The two coldest degree days for that year 1941, periods of 24 hours each, were 15.2 and 1.8, when 945,726 and 873,310 lb water, respectively, were used.

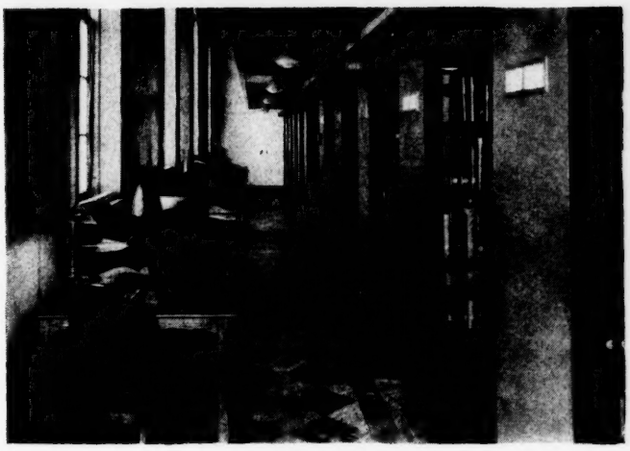


Interior of the boiler house showing two of the three boilers.

Monthly average of coal for the heating season 1941-42 was 924 tons, with a daily average of 33 tons. Steam for heating the various buildings is reduced to 5 to 14 lb, according to the weather. For the two laboratories, also using process steam, the pressure is reduced to 50 lb. Forced draft fans, driven by Terry steam turbines are used for the boilers. Each building has a water heating unit, utilizing the central steam.

Butterfield House

The Butterfield plant originally had the H. B. Smith boiler, with an Enterprise oil burner. This was removed by the Perfection Grate & Stoker Company, and a steel plate substituted for a fuel bed, with the small stoker. Although the conversion job had to be done in a hurry, the plant is delivering a satisfactory amount of steam for heating and process work in both buildings.



Stack room of the Goodell Library. Herman Nelson units are under the windows.

Butterfield has four floors in the central section and three in each of the wings. Exhaust fans keep the building well ventilated. Ducts from the main rooms and kitchen, and an additional one from the toilets, lead to a ventilating shaft in the north wing. The dining room and recreation hall directly above the main rooms are provided under the windows with Herman Nelson DJ ventilating units. The Goodell Library, completed in 1935, also has Herman Nelson univents under the windows of the stack room and in the reading room which is very popular.

Besides the buildings on the large sprawling campus, the college has a 270-acre farm, with dairy barns housing 175 head of registered cattle, and the Tillson Experimental Poultry Farm and chicken houses, with more than 1,000 layers, all in scientifically heated buildings.

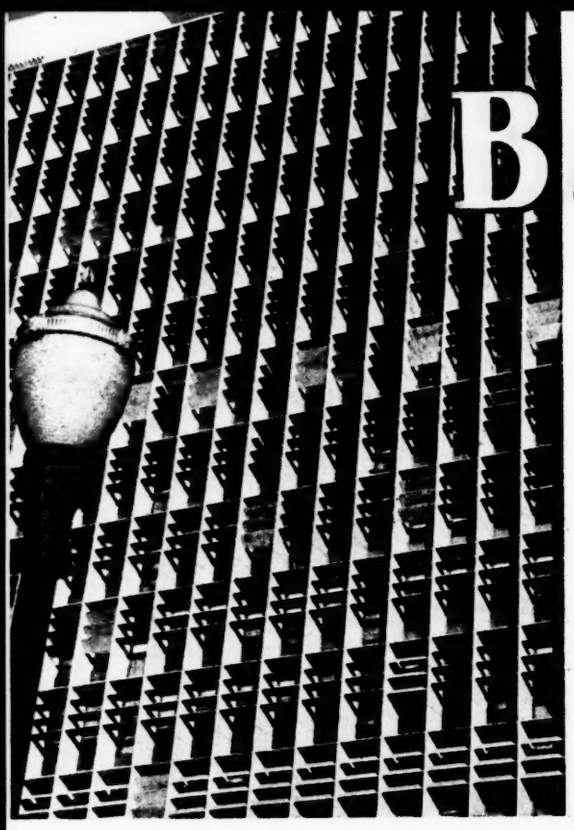
Engineering Credits

Plant Engineer, Lionel G. David.

Architect, Butterfield House, Lewis W. Ross.

Contractor, original Butterfield House oil heating plant, Geo. Reed & Co., Greenfield, Mass.

Contractor installing conversion grate, Perfection Grate & Stoker Co., Springfield, Mass.

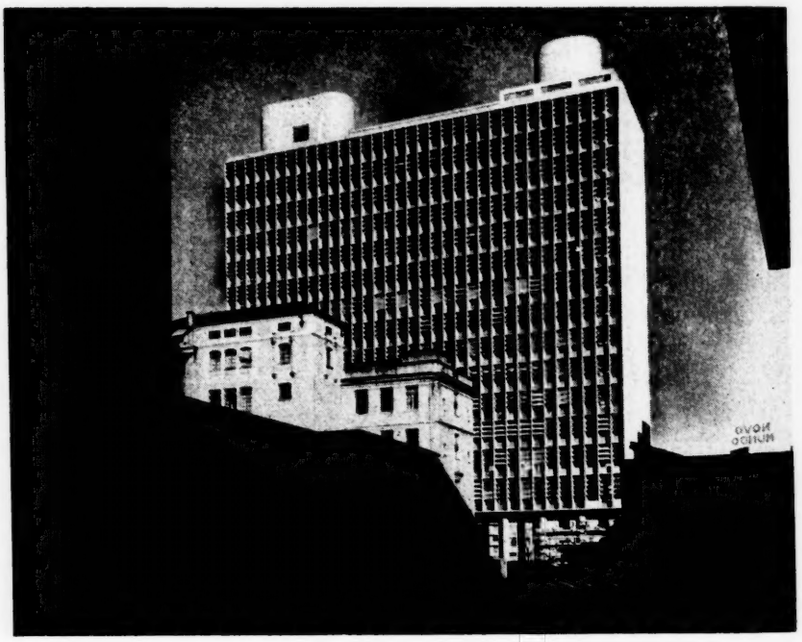


Building Brazil

A South American approach to the problem of reducing solar heat gains through windows of large buildings

On the north side of the Ministry of Education Building, Rio de Janeiro, thin concrete slabs of floor are cantilevered outwards about 4 ft from the windows. Vertical divisions are also 4 ft apart. These break up the facade to give the effect of a huge honeycomb. The south side of the building has no more need for sunshade than can be provided by venetian blinds. The building rests on pillared stilts, permitting free passage for pedestrians at the street level.

View of the complete Ministry of Education Building. The pattern produced by the sunbreak, and the lines of the reinforced concrete building, make this distinctive as compared to the architecture of the United States.

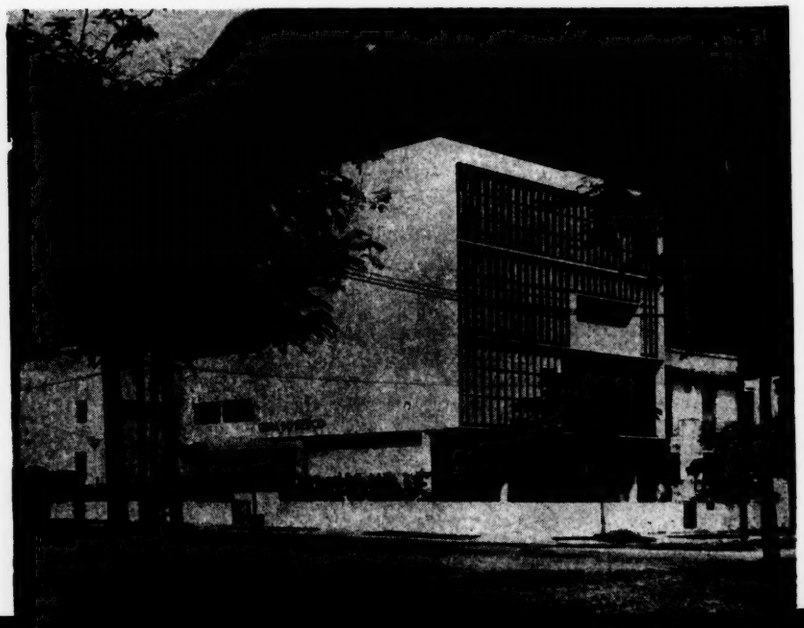


External lattice detail of the Day Nursery, Rio de Janeiro. These blinds are called "quebra sol" in Portuguese, and produce many interesting architectural designs.

G. E. Kidder Smith photo,
Museum of Modern Art, New York City

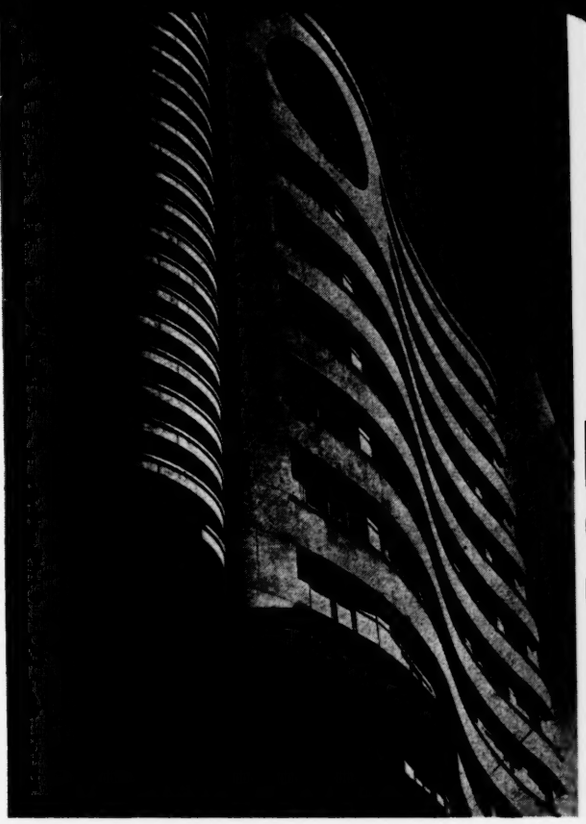
Day Nursery at Rio de Janeiro. View (below) shows the movable vertical sunshades placed on the side of the building that receives the greatest amount of exposure to the sun.

G. E. Kidder Smith photo, Museum of Modern Art, New York City



Much has been done with movable outside sunshades since the early experiments in 1933. In the Ministry of Education and Health Building (left) asbestos louvers in the upper portion of each rectangular cell are manually controlled and can be directed with the position of the sun. This permits sufficient air and keeps out all direct sun rays. As the louvers are regulated at different angles throughout the building, it is possible to secure an interesting variety of light and shade. in each room is a crank which controls the angle of the sunshade. A variety of architectural designs results in Brazil's cities from the use of many types of sunbreak devices.

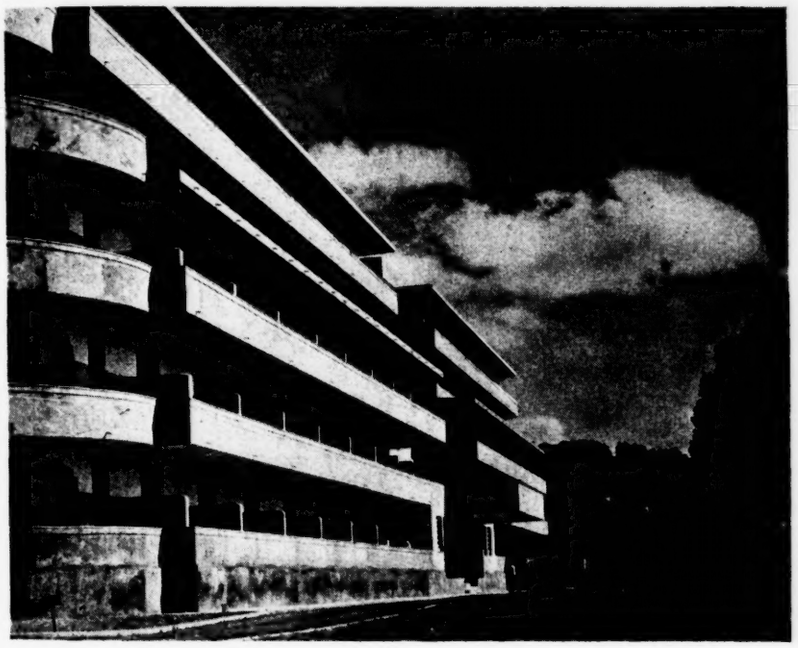
French, Portuguese and Italian architectural and construction ideas were used, while from the United States were obtained technical and labor-saving devices to provide comfort.



Still a different type of building. This is the Casa Pernambucanas, Sao Paulo.

Santa Terezinha Tuberculosis Sanitorium at Salvator, Baia. Wide balconies reduce the solar heat gain through windows.

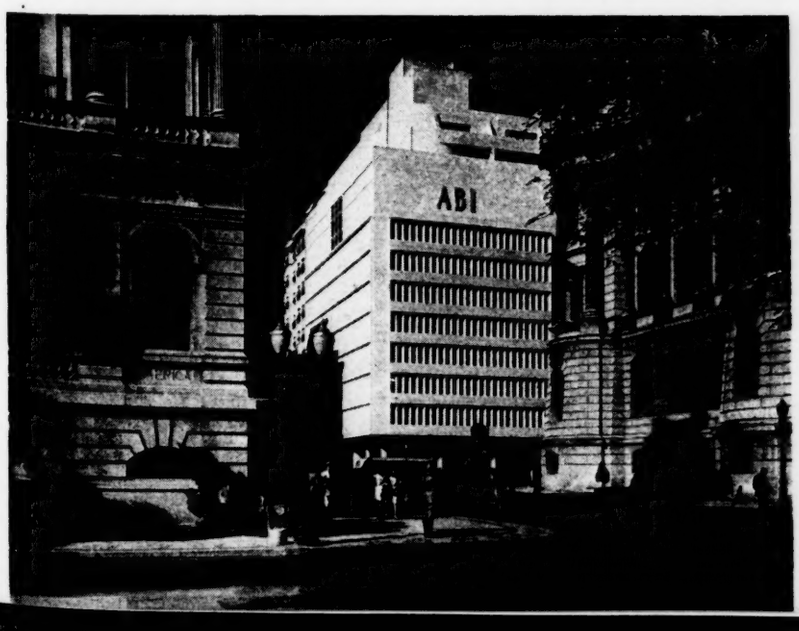
G. E. Kidder Smith photo, Museum of Modern Art, New York City

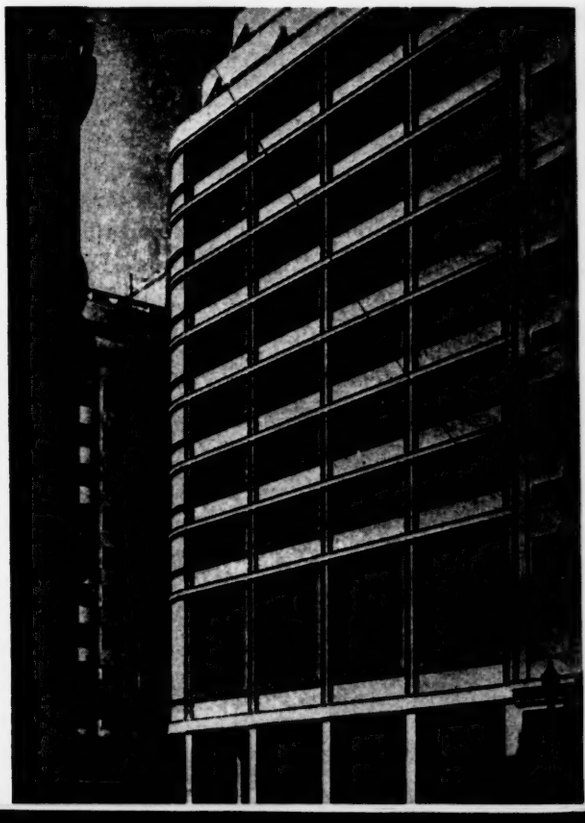


Institute of Industrial Insurance, Rio de Janeiro, has vertical sunshades to alleviate the effects of hot weather. Note how the lower part of the building is kept open for pedestrians.

G. E. Kidder Smith photo,
Museum of Modern Art, New York City

The Associated Press Building (below) has two hot sides which are provided with vertical sunshades. They are faced with rows of diagonally fixed concrete slabs, each 32 in. deep and 2¾ in. thick, which open on a narrow continuous passage. Some rooms have glass on the inner-side of the passage; others are left open.





WASHINGTON NEWS

Summarized by Loring F. Overman; OK Substantial Controls Program; Some Copper Released for Heating; Refrigeration Repairs Are Up-Rated.

As HEATING AND VENTILATING was going to press, the War Production Board announced that controlled materials have been made available for production of heating system controls for use in some 950,000 residential, commercial, institutional and industrial heating plants. Installers of the equipment will be able to purchase the controls freely.

In allocating the necessary material for production of these controls, it was WPB's aim to make fuel saving devices available in view of the expected fuel shortage during the coming heating season, officials said.

The control equipment for private dwellings proposed under this program consists of thermostatic regulator sets for coal hand-fired heating equipment, limit controls for installation on coal, oil or gas fired equipment already provided with some thermostatic control, and barometric dampers for use with oil and stoker-fired units. Each thermostatic regulator set consists of three instruments—thermostat, high limit control, and an electric damper operator.

For commercial, institutional, and industrial buildings such as schools, hotels, apartments and small factories, three types of control systems are included in the program.

1. An indoor-outdoor thermostat with the necessary accessories for direct control of heat generation;
2. A system consisting of an indoor or an indoor-outdoor thermostat and an electrically actuated operator; and
3. Zone control sets for use on large buildings where sectionalized or zone control is necessary because of the varying heat losses of the several areas of the structures.

The approved program calls for production during the third and fourth quarters of 1944 of the following products in the quantities listed:

	Quarter	
	Third	Fourth
Limit controls	23,700	18,000
Barometric regulators	200,000	80,000
Thermostatic regulator sets	175,000	127,000
Indoor-outdoor thermostats	11,228	6,747
Indoor thermostats	3,583	2,154
Operators	1,433	862
Valves (electric)	2,866	1,723
Valves (pneumatic)	2,389	1,435
Commercial barometrics	12,500	7,000
Sets consisting of pressure controller and light-duty operator	5,000	2,800
Sets consisting of pressure controller and heavy-duty operator	5,000	2,800
Sets consisting of over-fire draft controller and heavy-duty operator	5,000	2,800
Pumps	1,000	1,000
Steam accessories	25,000	25,000
Hot water accessories	25,000	25,000

For production of this equipment the following controlled materials have been allocated for the third quarter of 1944:

1,510 Short tons of carbon steel (including castings).
130 Short tons of alloy steel (including castings).
116,000 lbs. copper-base alloy—sheet and strip.
192,000 lbs. copper-base alloy—rod, bar and wire.
3,000 lbs. copper-base alloy—tubing and pipe.
25,000 lbs. copper-base mill products.
76,000 lbs. copper wire mill products.
113,000 lbs. copper and copper-base foundry products.
2,000 lbs. aluminum products (unclassified).

Advance allotments for the fourth quarter of 1944 will be issued in amounts not to exceed 75% of the quantities authorized for the third quarter.

Invasion Determining Factor

"It all depends upon the success of the invasion," is the stock answer, in Washington, to all questions regarding what industry may expect regarding military program cutbacks, reconversion, and new construction programs involving civilian goods. While uncertainty appears the only safe forecast for some months, it is encouraging to know that as much time, thought, and paper work is being spent on postwar planning as on wartime problems in Washington circles. Indeed, top-flight military men have dropped the thought that the planners are trying to see over the top of the hill before the final climb has hardly started.

War production records belie this conclusion, however. It will be noted that although WPB officials dealing with heating, ventilating and air-conditioning subjects may talk loudly about being ready for post-war activities, they play the cards close to the table when it comes to actually relaxing controls that would switch either materials or manpower from military to civilian production.

Task Committees Active

Assisting WPB in its dual task of keeping the war machine running while planning to shift gears into civilian production at the earliest possible moment, are numerous task committees composed of industry representatives. Current and future pricing matters, too, are under discussion, with a meeting of the newly-appointed price advisory committee representing manufacturers of commercial refrigeration condensing units scheduled to meet in Washington on June 13.

Smaller War Plants Problem

Efforts of the Smaller War Plants Corporation to give small manufacturing plants the break when the time comes to convert part of the nation's industry to civilian production, have revealed that the plumbing and heating industry does not exactly conform to this pattern. By means of charts presented before the Senate Small Business Committee on May 9, Maury Maverick, chairman of the Smaller War Plants Corporation, was able to prove that in the over-all war production picture, smaller plants are producing less than 10% of the munitions being shipped. This led to the conclusion that these smaller plants could be released from war contracts at an early date without materially affecting the war production program.

The conclusion is not borne out, however, in the plumbing and heating industry, where smaller plants carry the major part of the load. Following is the comparison between the overall picture and that of plumbing and heating:

MUNITIONS SHIPMENTS IN METAL PRODUCTS INDUSTRIES
Fourth Quarter, 1943

Total All Products		Plumbing and Heating	
No. of Workers per Plant	Percent of Total Production	No. of Workers per Plant	Percent of Total Production
1-99	10.9%	1-99	23.6%
100-249	6.3	100-249	27.5
250-499	5.9	250-499	19.6
500-999	8.2	500-999	17.8
1000-2499	13.1	1000-2499	6.1
2500 and over	55.5	2500 and over	5.4

The indication that the plumbing and heating industries do not conform to the pattern whereby the Smaller War Plants Corporation seeks to convert small industries first, may be worthy of study and counter proposals on the part of those active in postwar planning.

Shipments of combat material from 85 plants that were engaged primarily in the manufacture of domestic and commercial refrigeration equipment before the war reached an all-time high of almost $150,000,000 in the last quarter of 1943, the War Production Board reports. Shipments of combat material have been mounting steadily since the beginning of the war.

Shipments of all products—combat material, refrigeration equipment, and other goods—from the same plants totaled more than $200,000,000 for the same period. Enough unfilled orders of all kinds were on hand at the end of 1943 to keep the industry busy for about a year at the fourth-quarter rate of production, WPB said. This does not take into consideration possible cutbacks in military programs.

Total employment in the 85 plants reached a peak of 73,000 wage earners in October, 1943, an increase of 60% over the June, 1942, total. Overall employment and unfilled orders continued at a high level through the end of 1943, though both had declined slightly from the fall.

More than half of the workers added after the middle of 1942 were women, with the result that women constituted 23% of the employes in the industry in January, 1944, as compared with 8% in June, 1942. The number of women employed in individual plants varied widely. In January, 1944, no women were employed in over 20% of the 85 plants, while more than half of the workers in a few plants were women.

Seventy-four of these plants, included among the 309 plants classified in the refrigeration equipment industry in 1939, accounted for 90% of the total production ($279,000,000) by the industry in that year and for 89% of the 35,000 wage earners then in the industry.

Some Copper Released

Limited restoration of copper and copper base alloy products to replace steel in the manufacture of specified items of extended surface heating equipment, including blast-heating coils, convectors and unit heaters, was authorized May 16 by WPB. The action, affected by amendment of Conservation Order M-9-c, is expected to result in a saving of approximately 350,000 man-hours a year. Need for emergency repairs and replacements will be greatly reduced, WPB officials said, while approximately 50% in manufacturing time will be saved by the use of copper in place of substitute materials previously required.

A survey of actual shipments for the fourth quarter of 1943 indicates the end use of this equipment to have been as follows: to the U. S. Army, Navy and Maritime Commission, 43.5%, of which 41.5% was for shipboard use; to plants producing war materials, 53.5%, and to plants producing civilian goods, 3.0%.

Furnace Production Static

Furnace production for the second quarter of 1944 will probably remain approximately the same or drop below the number manufactured during the first quarter, members of the Warm Air Furnace Industry Advisory Committee said at their recent meeting with government officials in Washington.

Anticipated production, according to estimates submitted by all furnace manufacturers on Form WPB-3316, was somewhat above the first quarter's output, but industry members felt that these figures were over-optimistic because of the loss of manpower in the foundries.

There are indications that relatively few manufacturers are producing the smaller size furnaces, and industry was asked to distribute more equitably among all manufacturers the burden of producing this type of furnace.

To Uprate Repair Parts

The Refrigeration and Air Conditioning Section of the General Industrial Equipment Division of the War Production Board has informed manufacturers and trade associations of the refrigeration industry that WPB is prepared to uprate to AA-1 orders for certain repair parts used by the industry.

This move has been taken to help solve difficulties that have developed in manufacture, delivery and installation of repair parts, WPB said. At present, the agency added, the repair parts covered are in short supply.

The telegram which the Refrigeration and Air Conditioning Section sent to the industry, telling of this action, follows:

"Please issue bulletins to your members, dealers and distributors informing them that wholesale and retail trades division is prepared to uprate to AA-1 repair parts for commercial and industrial refrigeration and air conditioning equipment, orders for which have been placed before February 15 and are as yet undelivered. The program covers the following items: Controls (pressure and thermostatic) capacitors and/or starting condensers for motors, control bellows, solenoid valves, liquid line strainers, refrigerant dehydrators, thermostatic and automatic expansion valves, compressor bodies, compressor repair parts, including but not limited to pistons, rings, flapper and disc valves, crank shafts, seals, piston pins, high and low side float valves. Program is limited to the items enumerated. Have PD 547 filed or refiled for uprating. Forms should clearly designate in section four that request is against special program refer to GIEQ program determination number twenty eight. Give case number and item number of PD 547 on which previous rating was received, or if for uprating of MRO rating list each MRO rating for which uprating is requested.

"STERLING F. SMITH, Chief
Refrigeration and Air Conditioning Section
General Industrial Equipment Division."

Comfort A-C Gets "Break"

With Freon denied comfort air-conditioning systems, and with "F-22" refrigerant recently added to the prohibited list through issuance of Order M-28-a, it had begun to look as though comfort air conditioning was doomed to go through the summer without getting a single nod from WPB.

But the merits of air-cooling are not entirely forgotten. Directive 1 to Limitation Order L-38, issued May 19, authorizes the manufacture of a limited number of "desert coolers"—evaporative coolers for use in homes of West Coast war workers who are forced to live under air conditions because of the location of certain war plants.

Desert coolers consist primarily of a fan powered by a fractional horsepower motor and an evaporative medium such as wetted excelsior. They are designed to lower the air temperature by the evaporation of water. While WPB's decision to permit their manufacture will not alter the production schedule of major air conditioning plants, it is a step in the right direction—a further tribute to the essentiality of conditioned air.

Corrosion Inhibiters

Fees and charges for corrosion inhibiter services for boilers and heating systems are exempt from price control, the Office of Price Administration announced May 23. This service consists of a special analysis of the customer's need for a corrosion inhibiter in his heating system by a person with the necessary technical knowledge and the use of prescribed chemicals to retard the corrosive action.

This action, effective May 27, was taken because the technical knowledge of the person giving the service, rather than the materials used, is the important factor involved in retarding corrosion within a heating system.

OPA believes it impracticable to try to regulate maximum prices for such an unstandardized service, and, in this particular case, that the absence of price control will not result in an increase of present prices. However, OPA will keep the corrosion inhibiter service under study and, if the necessity arises, take further action in the matter, the agency said.

NEWS OF THE MONTH

Non-War Buildings Urged by Housing Men

CHICAGO—Five hundred members of the National Association of Housing Officials at their annual meeting heard a report May 4 of its committee on post-war housing, approved by the board of governors. It recommended that some resumption of non-war housing construction be permitted before the end of the war if the materials and manpower situation permit.

This would ease the acute housing shortages to be expected in some communities when service men and war workers return home, it was held, and would also help the housing industry get ready for its big post-war job.

Emphasizing the magnitude of the task, with a million to a million and a half dwelling units a year needed for the first fifteen years after the war, the report asserted that the post-war years could be made "the golden age" of American housing. It said that the goal of adequate homes for all could be attained if private enterprise, the Government and labor cooperated.

Holding that local authorities should determine how and when war housing should be disposed of, the report urged that temporary structures be removed as quickly as possible after the war lest they give rise to new slums, and that permanent buildings should not be dumped on the market but offered to occupants, local housing authorities or private enterprise in such a manner as not to depress the real estate market.

It said that privately produced war housing on which mortgages had been foreclosed should be demolished unless housing of such nature would be useful to public housing authorities.

Philip M. Klutznick, newly appointed Commissioner of the Federal Public Housing Authority, said that there must be no compromise on the subject of the demolition of temporary war housing units after the war.

"We must steel ourselves to perform this job with dispatch and in a creditable fashion," he added.

A permanent Federal housing agency should be provided now, the post-war report urged, so that it could be ready and functioning when the war ended. It said that the actual planning and provision of housing was a local responsibility, but there should be an agency to coordinate all Federal activities, including administration of funds for aid in slum-clearance and low-rent housing and supervision of need, standards and planning in justification of Federal aid.

Saying that the national Government should not "control" housing, it advocated the end of Federally constructed and operated housing with the end of the war, except for reclamation projects.

Urging cooperation between private enterprise and public housing, it said that the achievement of post-war goals required unprecedented activity by private initiative and investment.

May Ventilate Tunnel

STAUNTON, VA.—The prospect of a ventilation job on the old Blue Ridge railroad tunnel at Afton, Va., loomed here following announcement that the Chesapeake & Ohio Railroad is contemplating leasing the tunnel for cold storage purposes.

Railroad representatives said the project is now under consideration. If the proposal goes through, fruits and garden produce could be preserved the year round. The temperature of the tunnel is 56F. The tunnel is brick lined, 4000 feet long and presumably could be supplied with air ducts so that fresh air could be pumped in to prevent mold and rotting.

Haines Speaks on Electronics

WASHINGTON—Electronic controls so sensitive they react to the heat of a person's hand will eliminate, in the not too distant future, the cold floors and drafts prevalent in the majority of homes today, John E. Haines, chairman of the postwar planning committee, Minneapolis-Honeywell Regulator Company, said in a talk May 10 before the local chapter of the American Society of Heating and Ventilating Engineers.

Electronic controls, Mr. Haines continued, will be valuable in connection with the air-conditioning and heating of both homes and industrial plants since they react to minute temperature variations. The use of electronics, combined with present-day temperature control equipment, will mean greater comfort—as well as convenience and safety—for the home and factory.

4000 Meet at C. T. S. C. Clinic

CHICAGO — At a record-breaking meeting, 4000 engineers gathered at the Hotel Sherman, March 30, for the 2nd War Production and related problems conference sponsored by the chicago Technical Societies Council.

The Clinic was held at the request of the War Production Board and was in cooperation with the Board and the Army and Navy. Principal speakers were John Collyer, president of the B. F. Goodrich Company, and Rear Admiral A. S. Carpender.

The purpose of the conference was to expedite the war effort by providing a means for the exchange of mutually beneficial ideas among engineering, technical and scientific societies, and interested manufacturers in the Chicago area. The conference was held in a series of 33 panel sessions in which all phases of war production and related problems were discussed. All panel discussions were led by recognized experts in their fields.

Composed of the representatives of 36 societies, the aims of the Chicago Technical Societies Council are: (1) to provide a medium for cooperative action by the engineering, technical and scientific societies in the midwest on matters of mutual interest which are beyond the scope of individual societies or which can be performed better by cooperative action; (2) to provide means for more effective public service by the member societies; and (3) to cultivate greater appreciation by the public of the part which engineering and scientific professions have contributed to human welfare.

The Chicago Council is composed of two delegates from each member society including the American Society of Heating and Ventilating Engineers. Those desiring membership or further information should write to K. H. Hobbie, corresponding secretary, Chicago Technical Societies Council, care of the Driver-Harris Company, 1140 West Washington Blvd., Chicago 7, Ill.

Rose Joins Coal Research Group

PITTSBURGH—Bituminous Coal Research, Inc., has elected Dr. H. J. Rose, Mellon Institute, as vice-president and director of research in charge of the expanded investigational and developmental program of the bituminous coal industry. This organization of coal operators, associations, and railroads in the Appalachian and Mid-Continent coal fields is enlarging its research projects on coal production and utilization to meet wartime problems and to prepare for and strengthen the industry's post-war position. More than two million dollars will be invested in this research program during the next five years.

Dr. Rose has had extensive experience in the tech-

nical and administrative phases of coal research. Starting with The Koppers Company in 1918, he became assistant director of research of that organization. He has been with the anthracite industry since 1932, and is resigning as vice-president in charge of research, of Anthracite Industries, Inc., New York, N. Y., to accept the new position. In assuming direction of the broader domain of bituminous coal research, he is returning to his original field of activity. He has been associated with Mellon Institute throughout his professional career.

REMA Elects Schellenberg

A. B. Schellenberg

CHICAGO — A. B. Schellenberg, president of Alco Valve Company, St. Louis, was elected president of the Refrigerating Equipment Manufacturers Association at its annual meeting here April 25-26. Other officers are as follows: vice-president, F. J. Hood, Ansul Chemical Co.; treasurer (re-elected), J. A. Strachan, the Weatherhead Co.; secretary, George R. Allen, Mueller Brass Co. Newly elected to the board of directors are Charles H. Benson, Imperial Brass Mfg. Co.; J. P. Rainbault, General Electric Co.; H. F. Spoehrer, Spoehrer-Lange Co.; and R. O. White, Day & Night Mfg. Co.

At the convention fourteen heat transfer manufacturers represented at the meeting considered a new set of standards for rating refrigeration heat transfer equipment. A five-man committee will prepare the recommendations.

Simultaneously, the National Refrigeration Supply Jobbers Association met here and among other things discussed whether or not refrigeration jobbers should sell packaged refrigeration and air conditioning equipment.

"Or Equal" Clause Discouraged

NEW YORK—The Producers' Council, a national organization of manufacturers of quality building materials and equipment, has proposed a solution to the problems affecting the building industry involved in bidding practices which arise because of the use of the "or equal" clause in specifications. The plan advocated by the Producers' Council is as follows:

(1) All basic bids are to be based on exactly the same materials and equipment, thereby being truly competitive;

(2) Specifier may name one or several makes of a particular building product, but if more than one, he indicates which one is to be used as the basis for the regular bid; and

(3) Specifications also permit any bidder to submit an alternate price on any other named or unnamed materials or equipment which he thinks will meet the requirements. He does so by submitting what additions or deductions from his basic bid should be made if such alternates are used.

The system is said to be simple in operation and is expected to enable the owner and architect to decide before a contract is let what materials or equipment they wish to use, taking into consideration any advantages to be gained by using any of the alternates to the basic bid.

Suggests Plan for Post-War Civilian Construction

WASHINGTON—A plan for automatically removing wartime restrictions on the building of private residences, schools, stores, and other urgently needed civilian construction as fast as the necessary materials and manpower are released from the war program has been recommended to the War Production Board by Douglas Whitlock, president of The Producers' Council, national organization of manufacturers of building products.

Under the proposed plan, the WPB would grant permission for civilian construction to begin, without determination of the relative essentiality of each individual project as is the present practice, in any community where the following conditions exist:

(1) The construction is to be located in a War Manpower Commission Class III, Class IV or unrated area which has been so rated for one month or longer, and where it may be presumed that an adequate supply of labor is locally available;

(2) The applicant for permission to begin construction certifies that the work shall start within 30 days of the date of his application; and

(3) The applicant certifies that not more than 10% of the value of materials required for the construction shall be obtained on a preference rating of AA-3 (or higher, if specifically applied for and granted for obtaining any particular item) and that the remaining materials can be obtained either without a rating or with a rating lower than AA-3.

Columbia to Study High Frequency Heating

NEW YORK—A center for industrial research in the field of high-frequency electrical heating has been established at Columbia University, according to Professor Arthur W. Hixson, head of the department of chemical engineering.

The laboratory will be operated by Columbia chemical engineers and by technical experts from the Induction Heating Corporation of New York, which provided the high-frequency equipment for the new research enterprise. The Columbia department of chemical engineering will have full authority in guiding the laboratory program and in publishing the researches.

High-frequency heating results from passing alternating electric current, at several million times the frequency of current ordinarily used through non-conductors of electricity such as wood, plastic or rubber. In so doing, the high-frequency current generates intense heat which heats the substance internally instead of from the outside as in the oven method.

The research program, which will attempt to discover the basic principles of high-frequency heating and to apply them to industrial uses, is under the direction of Professor Hixson, and Professor Philip W. Schutz, of the department of chemical engineering. Everette K. McMahon, a graduate of the Georgia Institute of Technology and a specialist in chemical engineering applications of high-frequency heating, is in charge of the laboratory.

FHA Stimulates Fuel Conservation

WASHINGTON—A "summer plan" for insured financing of fuel saving installations, designed to assist in the national effort to conserve fuels, was announced April 1 by Abner H. Ferguson, Commissioner of the Federal Housing Administration.

Under the plan, the first payment on FHA-insured loans made during the spring and summer for this purpose may be deferred until the fall.

(Concluded on page 90)

News of the Month

(Concluded from page 89)

The FHA has notified the 5,000 private lending institutions authorized to operate under its Title I program that initial payments on loans made after April 1 may be deferred until November 1, 1944, providing the entire proceeds are used: (1) for the conversion of heating equipment to the use of other fuels, or the repair and replacement of heating equipment worn out or damaged; (2) for the application of insulation within existing structures; or (3) for installation of storm doors, storm windows, or weatherstripping.

The FHA's objective, in making this liberalization of its Title I loan terms, is to encourage home owners to undertake fuel conservation work during the warm weather season and thus prevent a heavy congestion of this type of work next fall, Mr. Ferguson said.

A. C. Fires Discussed

ST. PAUL—"Air conditioning system fires, like those of the automobile in its early days when the car which didn't burn up was usually the one which won the road race, will be largely eliminated when the causes are fully understood," said fire-preventionist John Neale, chief engineer of Underwriters' Laboratories, Inc., Chicago, on May 17 at the third day's session of the Northwest Fire School.

"Loss of life and property has resulted from air conditioning system fires but can be prevented in the modern air conditioning system," the speaker said, "by proper design and maintenance and the use of such safeguards as fire-resistive air filters, non-combustible ducts, fire-resistive duct linings and insulation, automatic fire shutters in the duct systems to prevent the spread of fire, and electric eye smoke detectors coupled with alarm systems and electrically connected to shut down the system when fire breaks out.

"Smoke, as well as fire, introduces a panic hazard," Mr. Neale said. "This is particularly serious," he pointed out, "as air conditioning systems are usually installed in public buildings where crowds are present."

Screening of the intake openings, frequent cleaning of the ducts and proper location of the intakes well above the floor level will help prevent accumulations of all manner of combustible trash and lint in the ducts, Mr. Neale advised.

Walter E. Becker

HOUSTON, TEX.—Walter Eugene Becker, widely known southern regional manager of the York Corporation, died unexpectedly here April 10, at the age of 57.

Mr. Becker's first business connection, made when he was 19, was as secretary of the Pilsbry-Becker Engineering Company, a distributor of York Manufacturing Company, then being organized in St. Louis. In 1911 he accepted the position of treasurer and manager of York Engineering and Supply Company of Houston, a York distributor. In 1919 he joined the Lane and Bowler Company, Memphis, manufacturers of deep-well pumps and related equipment.

Since 1922, Mr. Becker had been with the Houston branch of the York Ice Machinery Corporation, being made manager of the Houston branch in 1927. In 1931 he was made southern regional manager, which brought Atlanta as well as Houston under his supervision.

Vernon Edler

LOS ANGELES—Vernon Edler, vice-president and general manager of the Peerless Pump Division of the Food Machinery Corp., died May 1. He was general manager of Peerless Pump since 1935.

BRIEF REVIEWS

OVERFIRE JETS—Two publications on overfire jets for elimination of smoke and reduction of fuel waste and reporting the work done at Battelle Memorial Institute; both under authorship of Richard B. Engdahl, research engineer of the Institute. One publication is a 6 x 9 in. booklet, 14 pages, report No. VII, issued May, 1944 by Bituminous Coal Research, Inc., 803 Southern Building, Washington, D. C., and entitled "Application of Overfire Jets." Includes information on problem of overfire jets, limitations, construction, size selection, changing the amount of air, location, silencing, and other practical information. The second publication is an article entitled "Design Data for Overfire Jets" and covering essentially the same information, reprinted from *Combustion*, March, 1944.

INSULATION—A commercial standard CS117-44 on Mineral Wool for High Temperature Installations and covering blankets, blocks, insulating cement and piping insulation for heated industrial equipment has been adopted by the National Bureau of Standards. Standard is available in mimeographed form, TS-3699; will later be available in printed copies. 30 pages.

COKE—A mimeographed 6-page Report of Coke and By-Products from Coal-Gas Retorts in 1943, issued as one of the Mineral Industry Surveys, published by the Bureau of Mines, United States Department of the Interior.

NEOPRENE—A 5¾ x 9 in., paper bound, 46-page bulletin, published by the U. S. Department of Labor, Division of Labor Standards, and devoted to subject of safeguarding workers handling Neoprene. Booklet is the first of a series on safeguarding rubber workers. Includes a chapter on Engineering Control of Solvent Vapors, by Carl Toothaker, U. S. Rubber Co., Naugatuck.

OIL SHORTAGE—A 5¼ x 8⅛ in. brochure of 20 pages and entitled "There Will Be Enough Oil," an address by Wallace E. Pratt, vice-president and director, Standard Oil Company, delivered at the annual dinner of the Oil Heat Institute of America in March.

VALVES—Printed copies of Simplified Practice Recommendation R204-44, Bronze Pop Safety Valves, and Bronze, Iron, and Steel Relief Valves, are now available, according to the Division of Simplified Practice, National Bureau of Standards. The recommendation includes bronze pop safety valves, and bronze, iron, and steel relief valves suitable for steam, oil, water, air, and gas in industrial service, and for marine service where applicable.

Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 5 cents each.

SAFETY—The U. S. Department of Labor's Division of Labor Standards has published "Safety Subjects," a revision of Blake's "Industrial Safety Subjects" which served as basic text material in the ESMWT Safety Engineering War Training course. The new bulletin contains the entire 25 monographs, revised and brought up to date. The chapters are arranged in logical sequence and the book should be valuable for use outside the safety courses both by the novice in the safety field who wishes to get a comprehensive picture of industrial safety fundamentals, and by the experienced safety man who wishes to brush up on certain phases of the subject. Free distribution is restricted to State labor departments and course supervisors and instructors. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 20 cents.

STREAMLINED

Tube-Turn welding fittings help to bring true streamlining to a piping system. They not only save space and weight, but permit neater layout and *more compact design*, with lines of piping nestling closely together, hugging walls and making the best use of corners or odd spaces. Insulation is far easier in piping systems where Tube-Turn welding fittings are used.

Tube-Turn seamless steel welding fittings themselves are basically streamlined. Their smooth inner [illegible] and full circularity reduce pressure loss and flow resistance at vital points where flow direction changes. No flow-impeding "offsets" where Tube-Turn fittings are used — no waves or ridges to accelerate corrosion or erosion! Write for Catalog 111.

TUBE TURNS (Inc.) Louisville, Kentucky. *Branch Offices: New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle . . . Distributors located in all principal cities.*

ARMY E NAVY M

TUBE-TURN

TRADE MARK

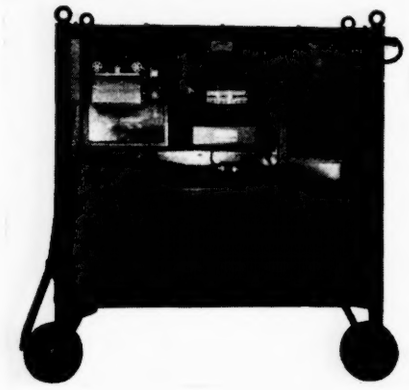
Welding Fittings and Flanges

NEWS OF EQUIPMENT AND MATERIALS

Induction Heater

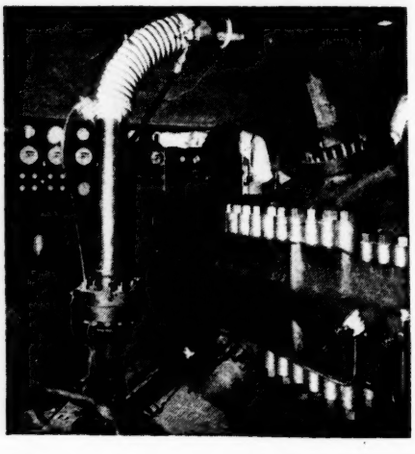
NAME—Smith-Dolan system of induction heating.

PURPOSE — Through the use of high amperage, low voltage, alternating current, a powerful electrical field is induced where desired and through



this induction heating, heat is created where desired for bending large size pipe, or for preheating as part of the welding process.

FEATURES—To preheat a pipe, before welding, three layers of asbestos paper are applied around the pipe for a distance of about twelve inches on each side of the weld. Special asbestos covered wire is wound around the pipe on each side of the weld, and the leads are then connected to the transformer supplying the high amperage, low voltage current. To maintain proper temperature control, two thermocouple wires are tack welded onto the work, and the wires run to a pyrometer, either of the recording or non-recording type supplied by the maker. When the predetermined temperature is reached, the current is cut off so that the actual welding can proceed. Illustrations show the standard single transformer with automatic control equipment, and a



large pipe being preheated so that it can be bent while in place. A feature of preheating is that it prepares the metal to absorb strains normally set up by the electric welding arc.

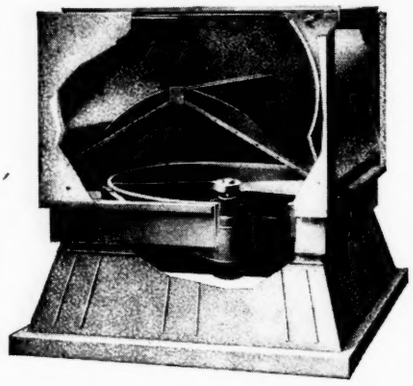
MADE BY — *Electric Arc, Inc., 152 Jeliff Ave., Newark 8, N. J.*

Iron Lung Roof Ventilator

NAME—Iron Lung roof ventilator.

PURPOSE—For ventilation of heavy industrial buildings.

FEATURES — A power type roof ventilator with axial flow fan, dampers which open automatically when power is turned on and close when power is off, heavy galvanized iron base, chassis of heavy steel welded into one piece, equipped with slip-slop hinges, and rain gutters for carrying off excess water collected in ridge gutter. When fan is operating and dampers open, rain and snow are ex-



pelled by force of air stream. Dampers have no bearings; instead, use a self-cleaning hinge.

SIZES AND CAPACITIES—Available in all standard sizes from 20 to 60 in., using motors of from ¼ to 10 horsepower, and with exhaust capacities ranging from approximately 3500 to 60,000 cfm.

MADE BY—*Powermatic Ventilator Co., 4019 Prospect Ave., Cleveland, Ohio.*

Liquid Level Indicator

NAME—U-C indicator.

PURPOSE—For indicating position of liquid level content of drums containing oil.

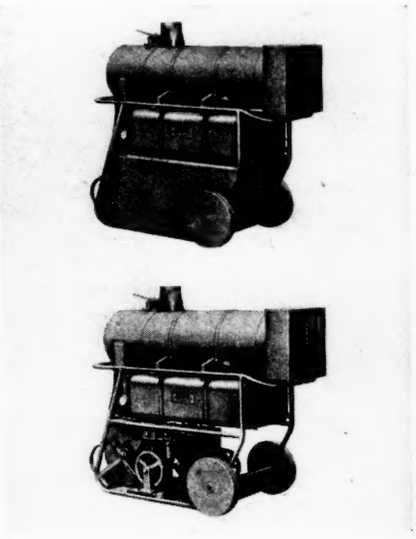
FEATURES—Has now been made adaptable to a 30 gal. drum in addition to the 55 gal. steel drums in which it has been used for some years. Device is applicable to either 30 or 55 gal. drums and can be transferred as easily as a faucet, it is claimed.

MADE BY—*Teehtmann Industries, Inc., 828 N. Broadway, Milwaukee, Wisc.*

Portable Heater

NAME—Janitrol portable heater.

PURPOSE — Heating mobile truck repair units; supplying heat for concrete mixing or preventing concrete from freezing during severe weather; localized heating in shipyards,



factory yards, and for many other uses where a portable heater would be suitable.

FEATURES — This unit embodies the same principles of combustion used in the Janitrol aircraft heater made by this company. It embodies the same whirl flame combustion principle which permits instant ignition in sub-zero temperatures. The flame is made to whirl by tangential introduction of air into the combustion chamber. Top of illustration shows the portable unit with sideboards and the lower photograph shows the heater with sideboards removed.

SIZES AND CAPACITIES—Output rating, 250,000 Btu per hour; tank capacity, 25 gallons or sufficient for eight hours operation; weight of unit, 270 lb.

MADE BY—*Surface Combustion, Toledo, Ohio.*

Heat Timer

NAME—Heat Timer.

PURPOSE—Indoor-outdoor weather controls for multi-family residential buildings and large commercial installations.

FEATURES—Designed for hand-fired coal, oil-fired and stoker-fired boilers. Timer is electrically operated utilizing low voltage of 24 volts to minimize installation expense. It includes an outdoor element and indoor ele-

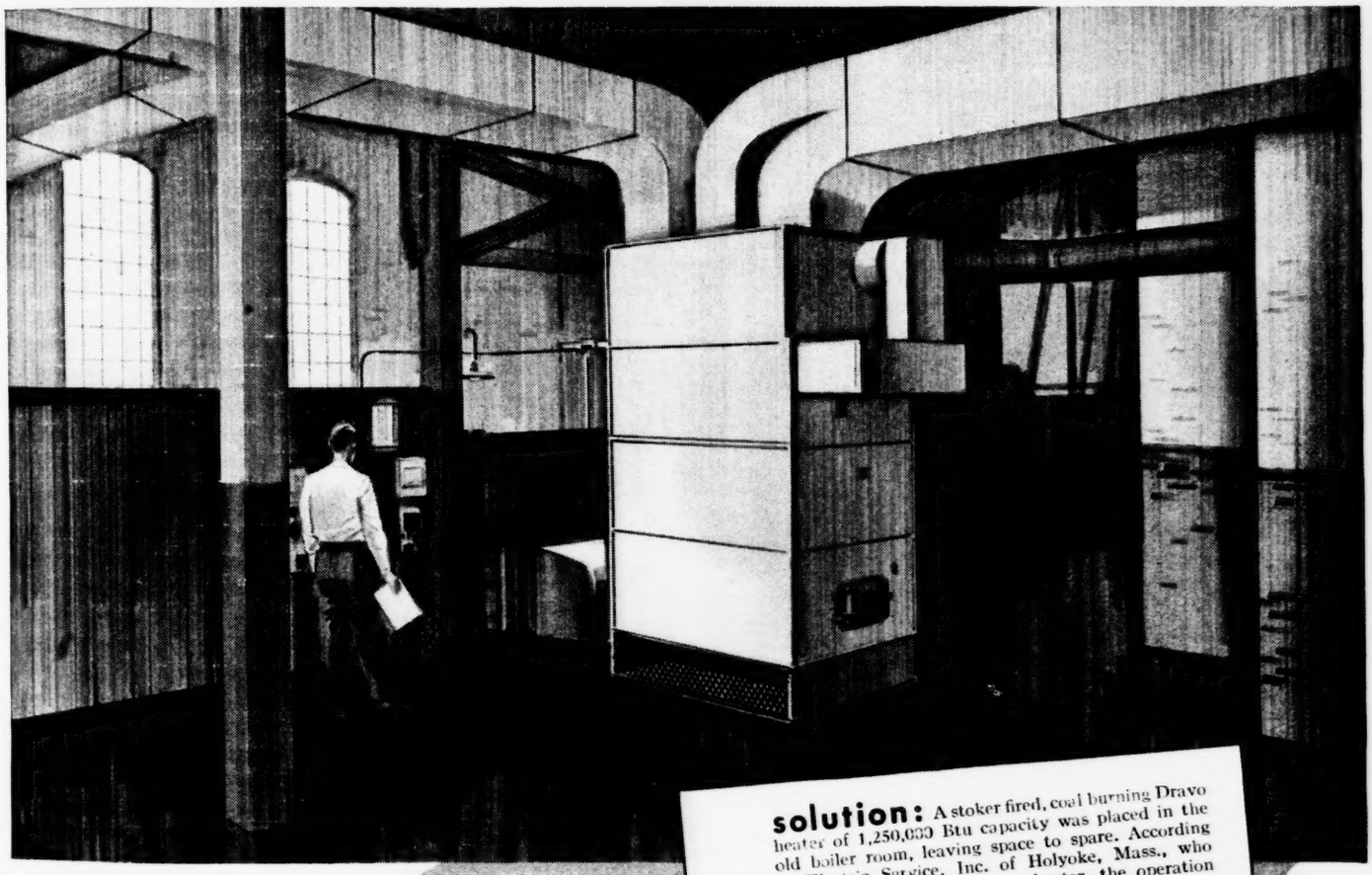
(Continued on page 94)

simple problem:

replace steam boiler in old two-storey building ... maintain 65° throughout ... day and night

A small Massachusetts firm engaged for many years in the manufacture of special machinery, found itself facing increased war production with a steam system too old and inefficient to satisfy heat requirements. The building was so cold on many winter mornings that the mechanics wasted much of their time trying to keep warm. The old bricked-in boiler was taking up much badly needed space. To save fuel, steam was kept up only during the daytime. This firm, faced with vital war contracts, needed warmth for their building and it had to be provided simply, quickly and efficiently.

DRAVO CORPORATION · PITTSBURGH



solution: A stoker fired, coal burning Dravo heater of 1,250,000 Btu capacity was placed in the old boiler room, leaving space to spare. According to Electric Service, Inc. of Holyoke, Mass., who engineered and installed the heater, the operation is remarkably clean. A duct system supplies air to maintain 65° temperature throughout the building day and night. Fuel savings were found to be 20%.

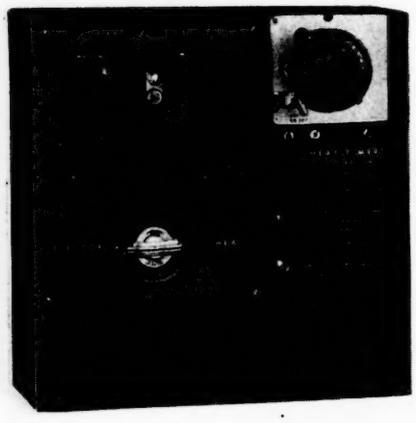
Bulletin 509 will tell you more about Dravo Heating

DRAVO

Heating

(Continued from page 92)

ment attached to either system or boiler and control panel mounted at any distance from either the outdoor or indoor elements. Control panel includes provisions for operating either: (1) automatically in accordance with outside weather; (2) cycling, which provides a fixed number



of "on" minutes of heating per cycle, or (3) a time delay provision for restricting the "on" cycle after circulation has been established in building for a pre-determined number of minutes. Circulation must be established completely in the building before the timing cycle starts, thus assuring adequate heating in the difficult portions of the building.

LITERATURE AVAILABLE — Illustrated booklet and installation instructions.

MADE BY—*The Heat Timer Corp., 160 Fifth Ave., New York, N. Y.*

Electric Manometer

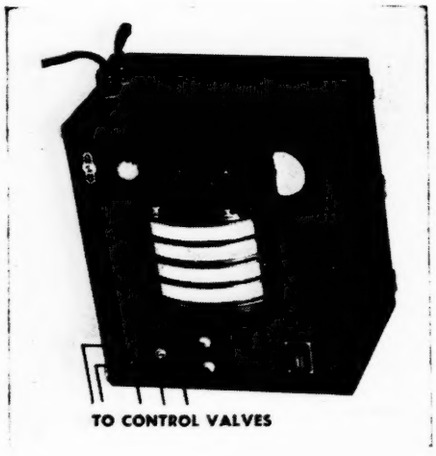
NAME—Electric manometer.

PURPOSE—For measuring minute pressures.

FEATURES—Small pressures are converted into an electrical reading by a very sensitive pressure measuring device. Pressures are converted into actual inches and tenths readings on a drum indicating unit.

SIZES AND CAPACITIES—Range of 0 to 100 in. of water with a sensitivity of 1/4 of 1/10 of 1 in. with an accuracy of plus or minus one tenth of 1%. Also available lower ranges of 0 to 5; 0 to 30; and 0 to 50 in., having correspondingly better sensitivity with same percentage of accuracy.

MADE BY—*Trimount Instrument Co., 37 W. Van Buren St., Chicago 5, Ill.*



Sturtevant Heater

NAME—Sturtevant Heavy Duty Steel Heater.

PURPOSE—Heavy duty application in industrial heating, air conditioning, vapor absorption, drying, and other processing work.

FEATURES—Said to possess maintenance and repair-free advantages of pipe coil heaters combined with performance of modern heating surface, with heating capacity increased 10

Above: Complete unit. Right: Cross-section showing header and inner tube construction

times due to addition of fins to heater pipes. Heaters constructed of 1 in. steel pipe threaded into cast iron headers. Inside these pipes are ⅜ in. steel pipes which carry the steam from header, distribute it to all heater pipes, prevent air binding, and provide a non-freeze characteristic. Wound around heater pipes are spiral fins of soft carbon steel strip 9/32 in. wide and tapered from .035 in. thickness at the edge attached to the pipe to .012 in. at the outside edge. Tapered construction of the fins said to provide greater heat transfer than fin of uniform thickness. After assembling, fins and pipes are passed through a metallic bath for bonding and protection against corrosion.

Standardized steel casings, of heavy gauge galvanized steel, die-formed for strength and uniformity are fitted with flanges, template punched, to facilitate assembly to other sections and to duct connections.

SIZES AND CAPACITIES—Four sizes, 20 in., 25 in., 30 in., and 35 in. in width across pipes. Each size furnished with pipe lengths from 2 to 10 ft. in 6 in. increments.

LITERATURE AVAILABLE—32-page catalog.

MADE BY—*B. F. Sturtevant Co., Inc., Hyde Park, Boston, Mass.*

Exhaust Heating Unit

NAME—Hexheat.

PURPOSE—An exhaust heating unit for airplane and industrial application.

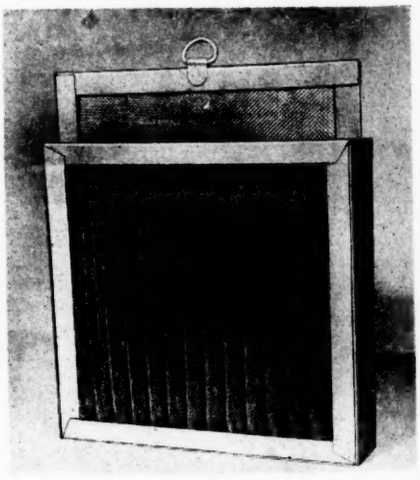
FEATURES — Of tube construction,

heater is proportioned and balanced to give uniform air flow control. Flow can be arranged for cross-flow, co-current-flow or counter-flow, whichever is most desirable for condition involved. Unit illustrated is of cross-flow type. Device originally designed for wing de-icing, cabin heating and related purposes but is adaptable to a wide variety of needs.

MADE BY—*Drayer & Hanson, Inc., 738 E. Pico St., Los Angeles 21, Calif.*

Oil Separator Filter

NAME—Air-Maze oil separator filter, type R-56B.



(Continued on page 96)

You Need These Bulletins—

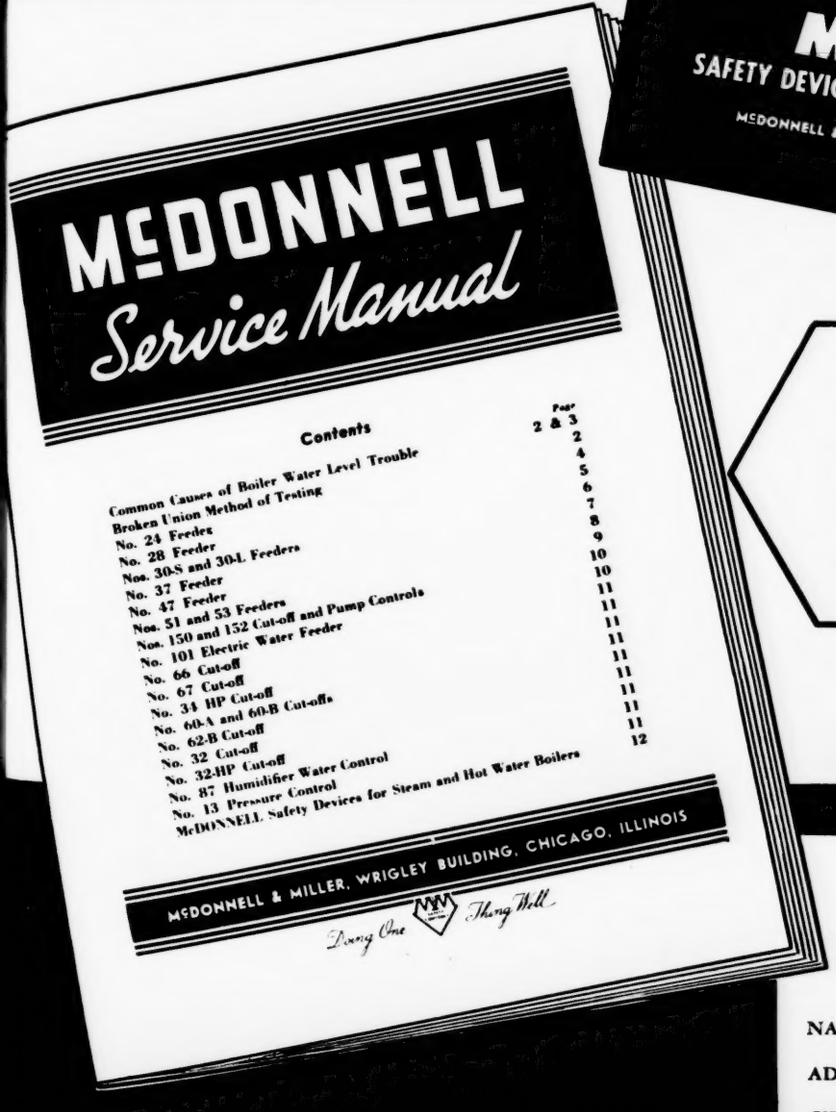
ONE of the worst saboteurs of them all is low water in steam boilers. And yet low water is the easiest of all to stop in its tracks. All that is needed is a relatively inexpensive McDonnell Boiler Water Level Control, properly installed and kept in good operating condition.

The two bulletins illustrated here are your guide in doing this. The new Condensed Catalog shows what type of control is needed for the essential boilers that do not have McDonnell protection. The new service manual shows how to keep McDonnell equipment going and bring the old models up to date.

If you haven't received these handy tools mail the coupon today for your copies.

In this current condensed catalog you will find complete price information, data covering service ranges, electrical ratings and condensed catalog information on McDonnell Boiler Feeders, Feeder Cut-off Combinations, Low Water Cut-offs, Pump Controllers, Safety Relief Valves and Humidifier Water Level Controls. Facts are organized so that it is easy to find the right control for the job, regardless of boiler size or pressure range.

CONDENSED CATALOG
and PRICE LIST
SERVICE RECOMMENDATIONS
Use this table to find McDonnell product suited to service conditions Then refer to product by catalog number on inside pages
(1) STEAM BOILERS
(2) HOT WATER HEATING BOILERS
(3) DOMESTIC HOT WATER TANKS AND HEATERS
(4) WARM AIR FURNACES
McDonnell No 417 or 517 Humidifier Water Level Controls
McDONNELL
SAFETY DEVICES FOR STEAM AND HOT WATER BOILERS
McDONNELL & MILLER, WRIGLEY BUILDING, CHICAGO 11, ILLINOIS
Doing One Thing Well


McDONNELL
Service Manual
Contents
Page
2 & 3
Common Causes of Boiler Water Level Trouble 2
Broken Union Method of Testing 3
No. 24 Feeder 4
No. 28 Feeder 5
Nos. 30-S and 30-L Feeders 6
No. 37 Feeder 7
No. 47 Feeder 8
Nos. 51 and 53 Feeders 9
Nos. 150 and 152 Cut-off and Pump Controls 10
No. 101 Electric Water Feeder 10
No. 66 Cut-off 11
No. 67 Cut-off 11
No. 34 HP Cut-off 11
No. 60-A and 60-B Cut-offs 11
No. 62-B Cut-off 11
No. 32 Cut-off 11
No. 32-HP Cut-off 11
No. 87 Humidifier Water Control 11
No. 13 Pressure Control 11
McDONNELL Safety Devices for Steam and Hot Water Boilers 12
McDONNELL & MILLER, WRIGLEY BUILDING, CHICAGO, ILLINOIS
Doing One Thing Well

This new service manual contains clear directions for testing out McDonnell Water Level Controls and covers each product individually with complete information as to servicing, ordering replacement parts, or bringing old types up to date with new conversion mechanisms. There are thousands of McDonnell Boiler Water Level Controls in service, all capable of doing a perfect job of protecting vital steam boilers. Their owners will welcome suggestions for keeping them in first class condition as covered by this manual.

McDONNELL & MILLER
1313 Wrigley Building, Chicago 11, Illinois

Doing One Thing Well
REG U S. PAT OFF

©M&M

COUPON BRINGS COPY

McDonnell & Miller
1313 Wrigley Building
Chicago 11, Illinois

Mail copy of bulletins checked: ☐ New Condensed Catalog. ☐ New Service Manual.

NAME_____

ADDRESS_____

CITY_____ STATE_____

(Continued from page 94)

PURPOSE—For removing oils from air in ventilating systems.

FEATURES—Consists of permanent, viscous impingement filter which removes dust and dirt and with removable oil collecting media that traps remaining oil particles. Removes oil and kerosene but does not remove oil smoke or liquids in a true vaporous state.

SIZES—Available in standard size.

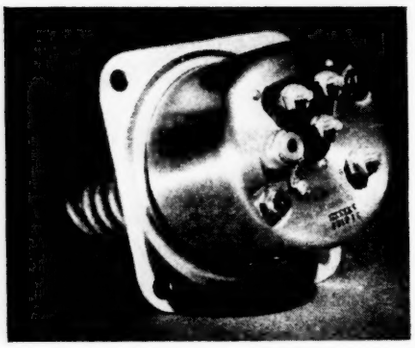
MADE BY—*Airmaze Corp., Cleveland 5, Ohio.*

Persons Control

NAME—Persons temperature control, types 530-1E, 531-E, 531D-1E.

PURPOSE—A direct duct-mounted type control switch.

FEATURES—Components include temperature element, switch mechanism,



adjustments, and housing. Highly sensitive coiled element used. Coiling affords a maximum area exposed while a "solid liquid charge" in the coil increases sensitivity which expands and contracts equally for each temperature change transmitting positive power for accurate operation of the switch mechanism. Switch will not shatter under heavy current loads to motors, can also be applied where switch is remotely located. Range of charge is —65F to 375F; range of operation, 75F; minimum temperature differential, 5F; tolerance, ± 2F, switch rating at 40,000 ft. altitude, 24 VDC, 25 amp., noninductive, 15 amp., inductive. Single-pole, double-throw switch.

SIZES AND CAPACITIES—Available in three types, type 530-1E, normally closed; type 531-1E, normally open, and type 531D-1E.

MADE BY—*L. M. Persons Corporation, 6301 Manchester Ave., St. Louis, Mo.*

Infra-Red Lamp

NAME—Birdseye RE-40 infra-red lamp

PURPOSE—To produce higher drying temperatures than possible with 250 watt sizes.

FEATURES—A 375-watt reflector type lamp made in clear and ruby glass. Has heat-proof Superlok base, efficient and durable ceramic heat reflector disc, the Wabash tungsten M-filament, and built-in reflector.

MADE BY—*Wabash Appliance Corp. 335 Carroll St., Brooklyn 31, N. Y.*

Fix-Iron

NAME—Fix-Iron.

PURPOSE—Powder which when mixed with water is effective for repairing broken, cracked, or defective metal pipings, etc., or for stopping leaks in boilers, furnaces, fire-pots, and other equipment.

FEATURES—No heat is required. Material is quickly applied with a putty knife and may be hammered into cracked or broken parts. Hardens rapidly. Has the same contraction and expansion as iron itself. Can be used with iron, steel, brass, or wood.

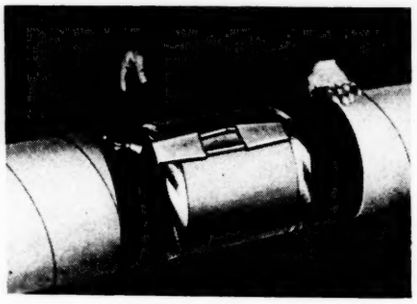
SIZES—Available in 1, 5, 25 and 100 lb cans and kegs. Household sizes in 1¾ and 7 oz glass jars.

MADE BY—*So-Lo Works, Loveland, Ohio.*

Ric-wiL Drive Coupler

NAME—Ric-wiL drive coupler.

PURPOSE—A coupler adaptable to mechanical or welded closure for Ric-wiL prefabricated insulated pipe conduit, said to eliminate need for skilled workmen and reduce installation time in the field when laying the conduit.



FEATURES—Insulated conduit is shipped to job site in 21 ft. sections completely prefabricated. Ends of helical corrugated conduit are expanded smooth at the factory, removing corrugations for a distance of 3 in. Bare pipe extends beyond ends of conduit for 3 more inches. After pipe has been coupled or welded, and insulation applied over exposed portions, smoothed ends of conduit are coated with waterproof sealing cement. A heavy-gage split connector sleeve is then slipped over the opening. Clamps are driven onto wedge-shaped channels over lapped joint, quickly making a strong watertight mechanical coupling. Where welded closure is required, cement is omitted and ends of sleeve lap-welded to conduit after clamps have been applied. Clamps are then removed and longitudinal seam lap welded. When conduit coupling is completed asphalt blanket, applied with heat over the entire closure area, fuses with factory-applied asphalt. Accessories for the complete system, including expansion loops, elbows, tees, anchors, and reducers, are prefabricated and equipped with the same drive coupler for assembly with conduit sections.

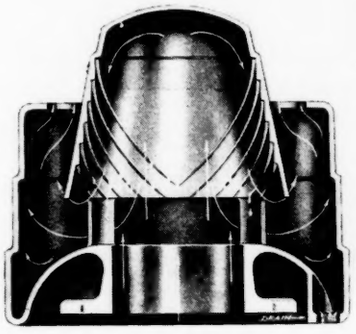
LITERATURE AVAILABLE—6-page bulletin, Form 4404.

MADE BY—*The Ric-wiL Company, 1572 Union Commerce Bldg., Cleveland, Ohio.*

Exhaust Head

NAME—Wright-Austin exhaust head, type FF.

PURPOSE—Removing moisture from exhaust steam and reducing objec-

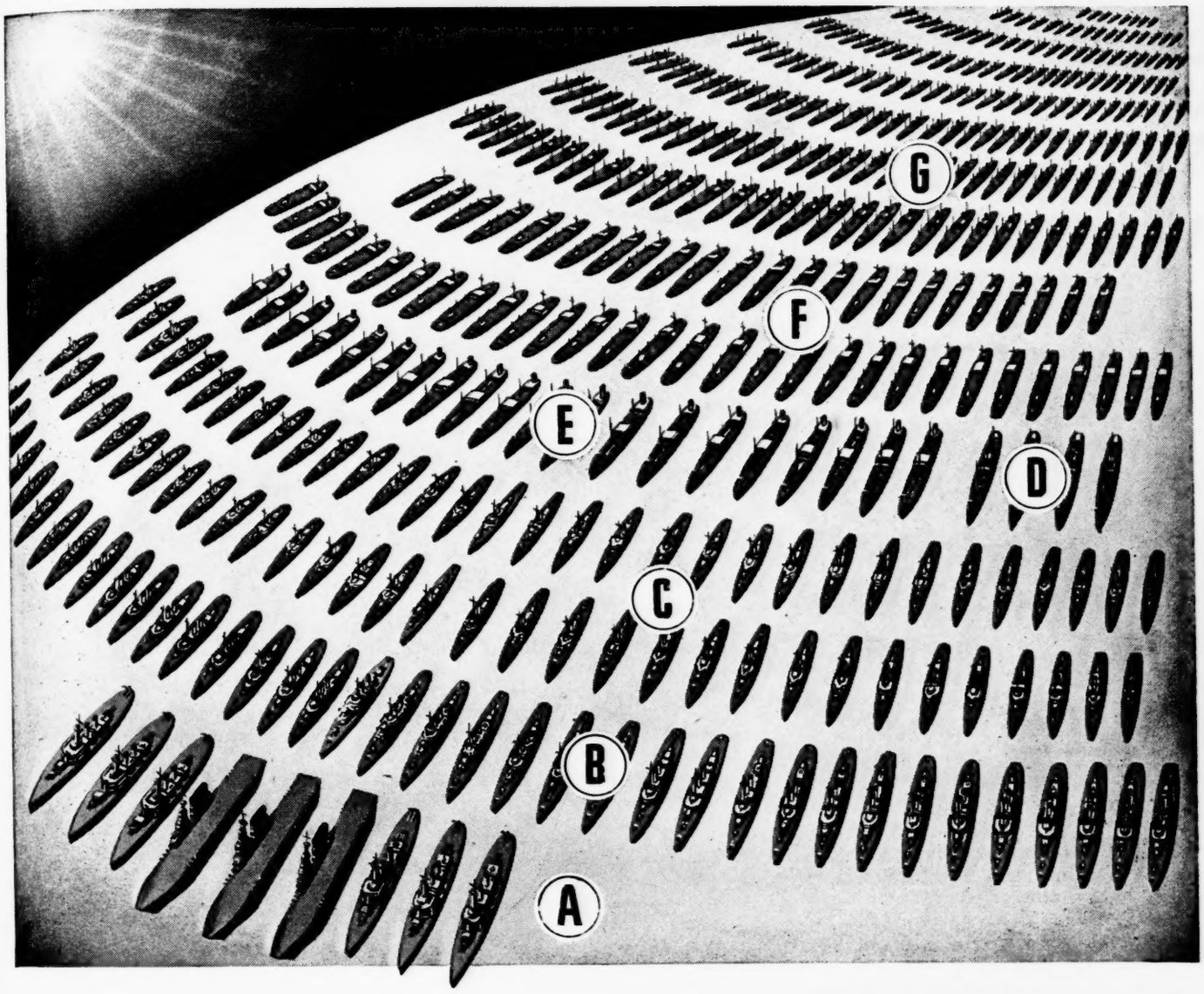


tionable noise ordinarily associated with exhaust head operation.

FEATURES—Device said wholly to eliminate water spray which is one of the principal causes of rust and erosion on roofs and adjacent stacks. Directional vanes or ribs are cast on the inside of the head, to collect and carry the separated moisture and oil out of the steam flow. For elimination of these contaminants, the normal steam velocity is slowed down by a two-stage expansion of the steam—first in the dome, and again in the body surrounding the dome. As a result of this construction, it is claimed that nothing but dry steam passes out through the exhaust head. Feature is an outlet opening much larger than the area of the intake pipe, permitting the purified exhaust to escape easily, without back pressure. This feature is said to assure practically silent operation, with no irritating "putt-putt" noises.

SIZES AND CAPACITIES—For all pipe

(Concluded on page 98)



The Fleet that Bethlehem built in '43

380 FIGHTING AND CARGO SHIPS

These ships equivalent in value to 1000 Liberty ships.

- (A) 3 Aircraft Carriers and 6 Cruisers
- (B) 37 Destroyers
- (C) 64 Destroyer Escorts
- (D) 4 Cargo Ships
- (E) 20 Tankers
- (F) 54 Landing Ships
- (G) 192 Liberty Ships

WORLD'S LARGEST SHIPBUILDER BETHLEHEM STEEL SECOND LARGEST STEEL PRODUCER

(Concluded from page 96)

sizes from 1½ to 14 in., standard or custom made to meet individual conditions.

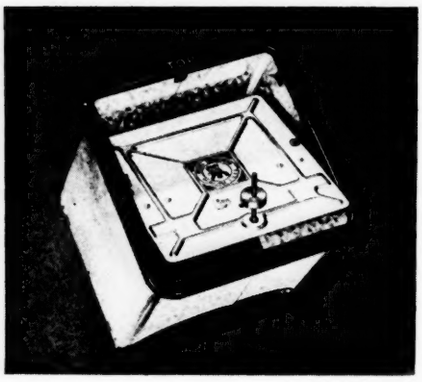
LITERATURE AVAILABLE—Catalog.

MADE BY—*Wright-Austin Co., 334 W. Woodbridge St., Detroit 26, Mich.*

Barometric Draft Control

NAME—Perfex barometric draft controls.

FEATURES—A new type of hinge pivot, made of spring steel, is said



to eliminate difficulties often characteristic of bearing type of hinge pivot, assure permanent calibration after the initial setting, and contributes to sensitivity of vane. Square construction of vane and thimble channel allows greater air volume than is obtained with conventional controls. Vane itself is made of aluminum for lightness, which also contributes to precision action and sensitivity. An off-center turn-weight is used to adjust action of vane. Once adjusted, it retains position without complicated locking or setting. Easily and quickly installed in either a vertical or horizontal pipe.

SIZES AND CAPACITIES—Four models, for use in pipes of sizes ranging from 6 in. to 12 in.

MADE BY—*Perfex Corp., Milwaukee, Wis.*

Sutton Blowers

NAME—Sutton motor driven blowers.

PURPOSE—General ventilating applications for various industrial and special uses.

FEATURES—Designed for continuous and quiet duty. The single inlet type can be used for suction, blowing, or both. Housing of furniture steel spot welded airtight and supported by cast iron and brackets; baked on crackle finish; outlet may be turned to any one of four positions—right, left, up or down. Outlet has removable nozzle adapter to permit use of round or rectangular duct as required. Multiblade wheels have steel back plates riveted to machined hubs.

SIZES AND CAPACITIES—Three sizes with 1/6, 1/4 and 1/3 hp motors, 500, 1,000 and 1,500 cfm free air delivery, respectively.

LITERATURE AVAILABLE—Bulletin No. 244.

MADE BY—*Sutton Mfg. Co., 112-114 W. Wilson Ave., Norfolk 10, Va.*

Small Dravo Heater

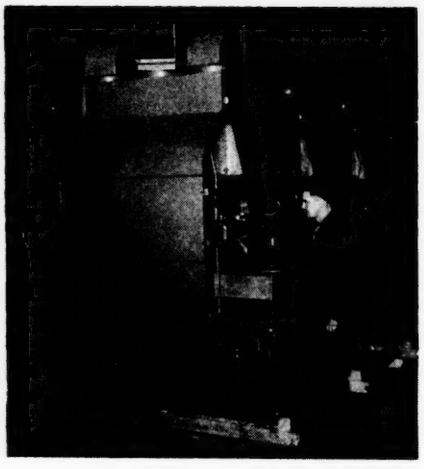
NAME—Dravo direct-fired heater.

PURPOSE—Designed to meet the problem of heating small structures or provide additional heat for limited areas.

FEATURES—New model is one which company is now supplying to armed forces to heat steel service igloos at advanced bases. Retains principal characteristics of regular line but on a smaller scale and with floor space requirements of 3 x 5¼ ft. Also can be suspended from wall. Equipped to burn either gas or oil. Thermostatically controlled.

SIZES AND CAPACITIES—300,000 to 850,000 Btu per hr output.

LITERATURE AVAILABLE—Bulletin No. 509-A.



MADE BY—*Dravo Corporation, Machinery Div., Heat Dept., 300 Penn Ave., Pittsburgh, Pa.*

Multi-Contact Timer

NAME—Multi-contact timer for remote control.

PURPOSE—To control a series of operations in definite order, automatically to reverse or alternate in operation a group of motors or devices, to operate in a predetermined sequence a series of valves, solenoids, or signals, as well as numerous other applications where sequence operations are of importance.

FEATURES—Solenoid starting mechanism is operated from a remote control momentary start button, so that the timer will go through its complete cycle or any part of its cycle of operation and stop. Reclosing the momentary start button will either continue or repeat the cycle as the case may be. They can be arranged so that in the event of a power interruption it is necessary to again press the remote control start button to continue the cycle, or, after power is restored to automatically continue the cycle of operation.

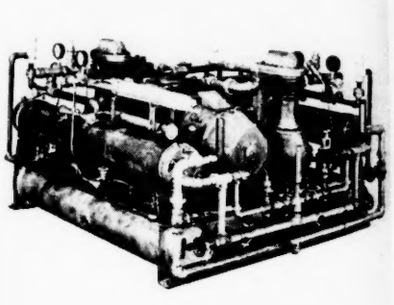
MADE BY—*The R. W. Cramer Co., Inc., Centerbrook, Conn.*

Packed Refrigeration Unit

NAME—Packaged refrigeration plant.

PURPOSE—For installation on Victory ships.

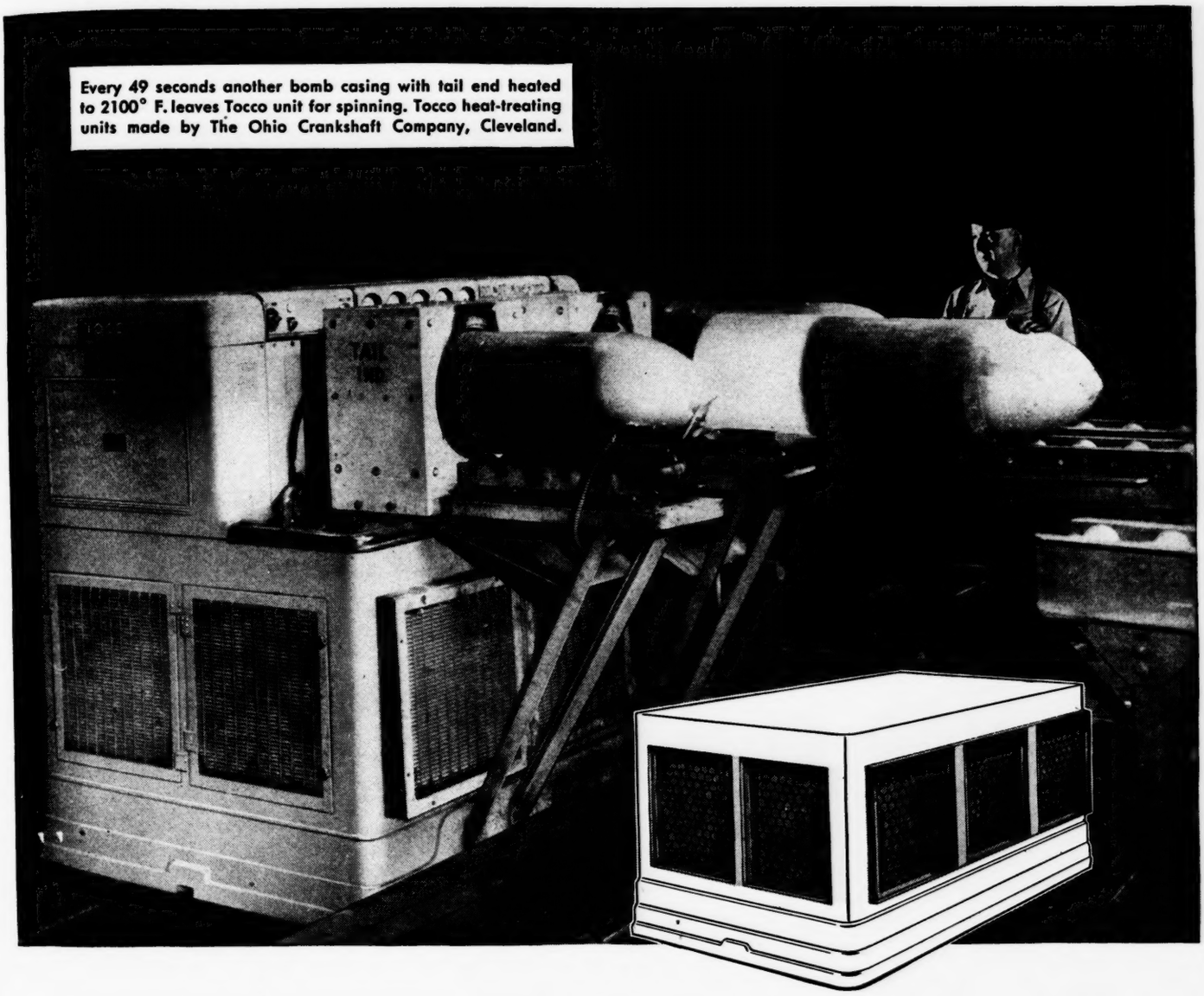
FEATURES—Manufacturer claims nearly 1600 sq ft of cargo area and 16,000



man-hours of installation time will be saved on 133 new Victory ships by use of this unit. Has combination twin refrigeration compressors, receivers, condensers and auxiliaries which by cross connections can be operated separately for both high and low temperature rooms. In emergencies either compressor can be connected to carry both high and low temperature simultaneously. Receivers form integral structural part of base, increase rigidity of framework at minimum of weight. Machine is built in form of a rectangle; piping and valves located for easy accessibility. Company now building similar packaged unit for other type vessels.

SIZES AND CAPACITIES—Total weight 3804 lb. Unit approximately 71 in. long, 68 in. wide, 42 in. high. Combined compressor capacity five tons; compressors driven by two 7½ hp motors. High temperature rooms 40F, low temperature rooms 15F.

MADE BY—*York Corp., York, Pa.*



Every 49 seconds another bomb casing with tail end heated to 2100° F. leaves Tocco unit for spinning. Tocco heat-treating units made by The Ohio Crankshaft Company, Cleveland.

What keeps Tocco's insides clean?

TOCCO IS A MACHINE to heat-treat steel by electrical induction.

Tocco units make better bomb cases faster. Heat airplane propeller ends to 2000° F. in 115 seconds. Increase output of drill chucks 600 per cent. In sum, bring to hundreds of manufacturing plants faster production, lower costs and improved products.

Tocco's insides consist of expensive, precision machinery. A motor-generator is its heart. To assure proper operating temperature for the enclosed electrical equipment, air is fan-circulated throughout the cabinet. This air must obviously be clean as a whistle. Dust-Stop* Air Filters inside the intake louvres (see inset) make it that way.

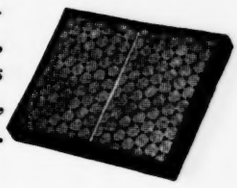
ARMY E NAVY

Saves Possible Expense

Dust-Stops are one of the contributing factors to Tocco's remarkably low maintenance costs, made possible by careful design and engineering of the complete unit.

All users of machinery equipped with Dust-Stops have the advantages of a quick-change, standard size filter that can be easily removed when clogged with dirt accumulations and replaced with a new, clean Dust-Stop in a few minutes.

Tocco is but one interesting example of how Dust-Stops can be designed and engineered into machines where dust must be controlled. For further information on this type of application write: *Owens-Corning Fiberglas Corporation, 1912 Nicholas Building, Toledo 1, Ohio; Fiberglas Canada, Ltd., Oshawa, Ontario.*



FIBERGLAS* DUSTOP AIR FILTERS

*T. M. Reg. U. S. Pat. Off.

Degree-Days for April, 1944

HEATING AND VENTILATING'S 16th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days[1]			Year[2]
	Degree-Days, April, 1944	Degree-Days, April, 1943	Degree-Days, April, Normal	Season, 9/1/43-4/30/44	Season, 9/1/42-4/30/43	Season, Normal, 9/1-4/30	Normal, 9/1-6/30
Abilene, Texas	88	31	27	2512	2301	2061	2061
Albany, New York	694	759	549	7010	7109	6397	6580
Albuquerque, New Mexico	386	163	288	4775	3597	4258	4298
Alpena, Michigan	846	849	789	7468	7783	7662	8299*
Anaconda, Montana	704	611	756	7285	7423	7493	8357**
Asheville, North Carolina	323	365	330	4152	4087	4161	4232
Atlanta, Georgia	181	176	132	2905	2865	2890	2890
Atlantic City, New Jersey	492	562	519	4815	4682	4956	5176
Augusta, Georgia	130	122	24	2259	2178	2161	2161
Baker, Oregon	615	512	615	6308	6307	6519	7163
Baltimore, Maryland	361	437	348	4420	4346	4511	4533
Billings, Montana	492	398	534	6146	6779	6743	7119
Binghamton, New York	661	751	594	6821	6599	6554	6808
Birmingham, Alabama	168	124	69	2873	2477	2352	2352
Bismarck, North Dakota	689	502	657	7819	8953	8809	9192
Block Island, Rhode Island	647	710	633	5526	5630	5311	5788
Boise, Idaho	488	331	435	5611	5312	5316	5552
Boston, Massachusetts	608	649	570	5865	5913	5800	6045
Bozeman, Montana	615	544	731	7265	7483	7724	8521**
Buffalo, New York	721	842	675	6774	6864	6475	6822
Burlington, Vermont	788	859	654	7872	7869	7238	7514
Butte, Montana	742	624	741	7855	8049	7424	8272
Cairo, Illinois	226	235	201	3903	3859	3909	3909
Canton, New York	782	864	684	7908	8101	7686	8020
Charles City, Iowa	631	582	612	7162	7816	7364	7588
Charleston, South Carolina	95	107	36	1870	1909	1769	1769
Charlotte, North Carolina	187	206	159	3106	3056	3120	3120
Chattanooga, Tennessee	232	188	144	3539	3251	3118	3118
Cheyenne, Wyoming	819	505	720	6952	6447	6894	7466
Chicago, Illinois	590	583	537	6245	6548	5715	5957
Cincinnati, Ohio	347	458	333	4869	5000	4684	4684
Cleveland, Ohio	596	649	564	5878	5849	5935	6155
Columbia, Missouri	419	315	303	5120	4931	4900	4922
Columbia, South Carolina	132	145	63	2461	2375	2364	2364
Columbus, Ohio	428	540	420	5308	5391	5311	5398
Concord, New Hampshire	760	800	669	7441	7474	7001	7353
Concordia, Kansas	534	273	342	5526	5313	5250	5315
Dallas, Texas	85	49	9	2418	2314	2256	2256
Davenport, Iowa	533	468	453	6054	6389	6171	6289
Dayton, Ohio	472	578	396	5692	5415	5183	5264
Denver, Colorado	651	291	534	5568	4895	5607	5874
Des Moines, Iowa	568	458	441	6267	6469	6266	6384
Detroit, Michigan	665	679	573	6417	6515	6264	6490
Devils Lake, North Dakota	742	658	756	8786	9785	9450	9970
Dodge City, Kansas	508	235	342	5413	4711	4988	5035
Dubuque, Iowa	593	517	489	6550	6961	6641	6790
Duluth, Minnesota	841	806	801	8558	9165	8746	9443
Eastport, Maine	803	871	786	7418	7546	7398	8520**
Elkins, West Virginia	503	621	501	5721	5454	5520	5697
El Paso, Texas	112	54	45	2802	2200	2428	2428
Ely, Nevada	806	507	—	7339	6095	—	—
Erie, Pennsylvania	671	725	609	6217	6139	6016	6273
Escanaba, Michigan	828	885	828	7736	8311	8118	8771*
Evansville, Indiana	317	357	276	4693	4726	4244	4244
Fort Smith, Arkansas	151	101	93	3204	3075	3147	3147
Fort Wayne, Indiana	609	634	474	6447	6483	5795	5925
Fort Worth, Texas	79	44	27	2369	2311	2148	2148
Fresno, California	216	107	135	2538	2398	2334	2334
Galveston, Texas	20	7	0	1161	1046	1016	1016
Grand Junction, Colorado	509	165	384	5311	4565	5430	5548
Grand Rapids, Michigan	625	655	534	6398	6582	6361	6535
Green Bay, Wisconsin	730	720	600	7366	7859	7503	7825
Greensboro, North Carolina	270	309	210	4026	3823	3529	3529
Greenville, South Carolina	196	208	195	3145	3105	3380	3380
Harrisburg, Pennsylvania	484	572	405	5457	5313	5285	5375
Hartford, Connecticut	598	665	531	6198	6240	5834	6036
Hatteras, North Carolina	186	241	255	2721	2518	2571	2571
Havre, Montana	498	437	630	6904	7988	8187	8700
Helena, Montana	623	533	646	7343	7953	7261	7898
Houston, Texas	22	16	0	1300	1212	1157	1157
Huron, South Dakota	671	526	570	7545	8023	7737	8004
Indianapolis, Indiana	423	518	384	5301	5618	5239	5298
Kansas City, Missouri	448	254	306	5104	4911	4950	4956
Kewanee, Illinois	575	534	472	6408	6763	5996	6139
Knoxville, Tennessee	257	267	210	3667	3663	3670	3670
La Crosse, Wisconsin	534	528	617	7205	7786	7139	7322
Lander, Wyoming	719	455	690	8025	7024	7384	7947

[1]Cumulative data identical with monthly figures for September only. In subsequent months, cumulative figures will show record for whole heating season to and including month in question.

[2]Figures in this column are normal totals for a complete heating season, September to June, incl.

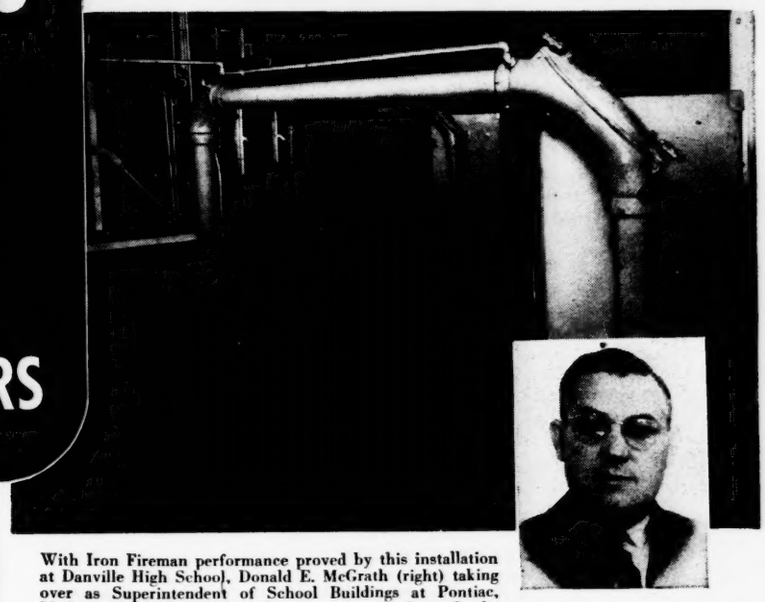
Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, and Sioux City, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., and Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

[Table concluded on page 102]

Boiler Output Doubled

WITH

IRON FIREMAN STOKERS



With Iron Fireman performance proved by this installation at Danville High School, Donald E. McGrath (right) taking over as Superintendent of School Buildings at Pontiac, Mich., promptly ordered Iron Fireman stokers for four schools.

Danville, Illinois, High School turned a struggling steam plant into a smooth-running system with ample reserve power — using the same 3 boilers

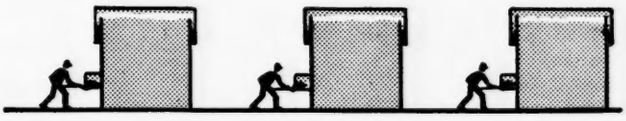
A TYPICAL example of how Iron Fireman firing saves fuel and manpower is the Danville High School. Previous to installation of Iron Fireman pneumatic spreader stokers, three hand-fired boilers failed to meet heating demands. After a season's heating with Iron Fireman, Mr. Donald E. McGrath, Superintendent of School Buildings, reported these ourstanding results:

"With Iron Fireman firing, we operated 40% of the time on *one boiler*, using two boilers only during early hours and peak loads—the third boiler always in reserve for emergencies. We had plenty of time for cleaning and readying each boiler in turn by alternate firing in two week cycles.

30% Coal Saving—Manpower Saved for Other Work

"Fuel savings averaged 30% or $1800 a year. Also we found our men had time to do many other jobs of improvement during their shifts. Elimination of part time labor, previously necessary, saved a further $200 a year."

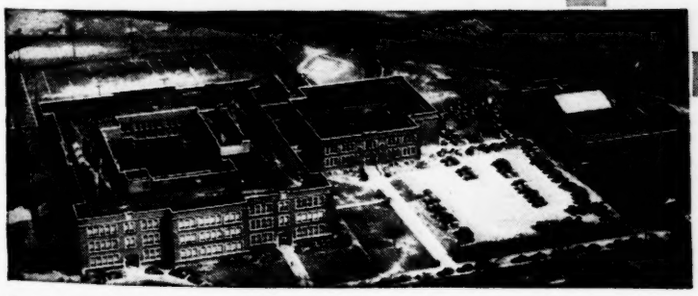
BEFORE installation of Iron Fireman Stokers three heavily fired boilers could scarcely carry the load.



AFTER installing Iron Fireman Stokers

1 Boiler carried the load 40% of the time—
2 Boilers carried all peak loads—leaving
1 Boiler always in reserve.

FUEL SAVING — $1800 A YEAR



Danville High School—a three story main building with a two story double gymnasium and swimming pool, a detached manual arts building and boiler plant. Boiler plant consists of three 225 h.p. four drum water tube boilers, now efficiently and economically fired by Iron Fireman Pneumatic Spreader stokers.

Iron Fireman Stokers Available NOW

Ask for Free Heating Plant Survey

Because they contribute so substantially to fuel and manpower conservation, Iron Fireman automatic stokers are now available to all users of 25 tons or more of coal annually. Our nationwide organization of qualified factory representatives and dealers is at your service. For a free survey showing what Iron Fireman firing can do in your building or plant, write Iron Fireman Manufacturing Co., 3430 West 106th St., Cleveland 11, Ohio.

IRON FIREMAN AUTOMATIC COAL STOKERS

Degree-Days for April, 1944 (Concluded)

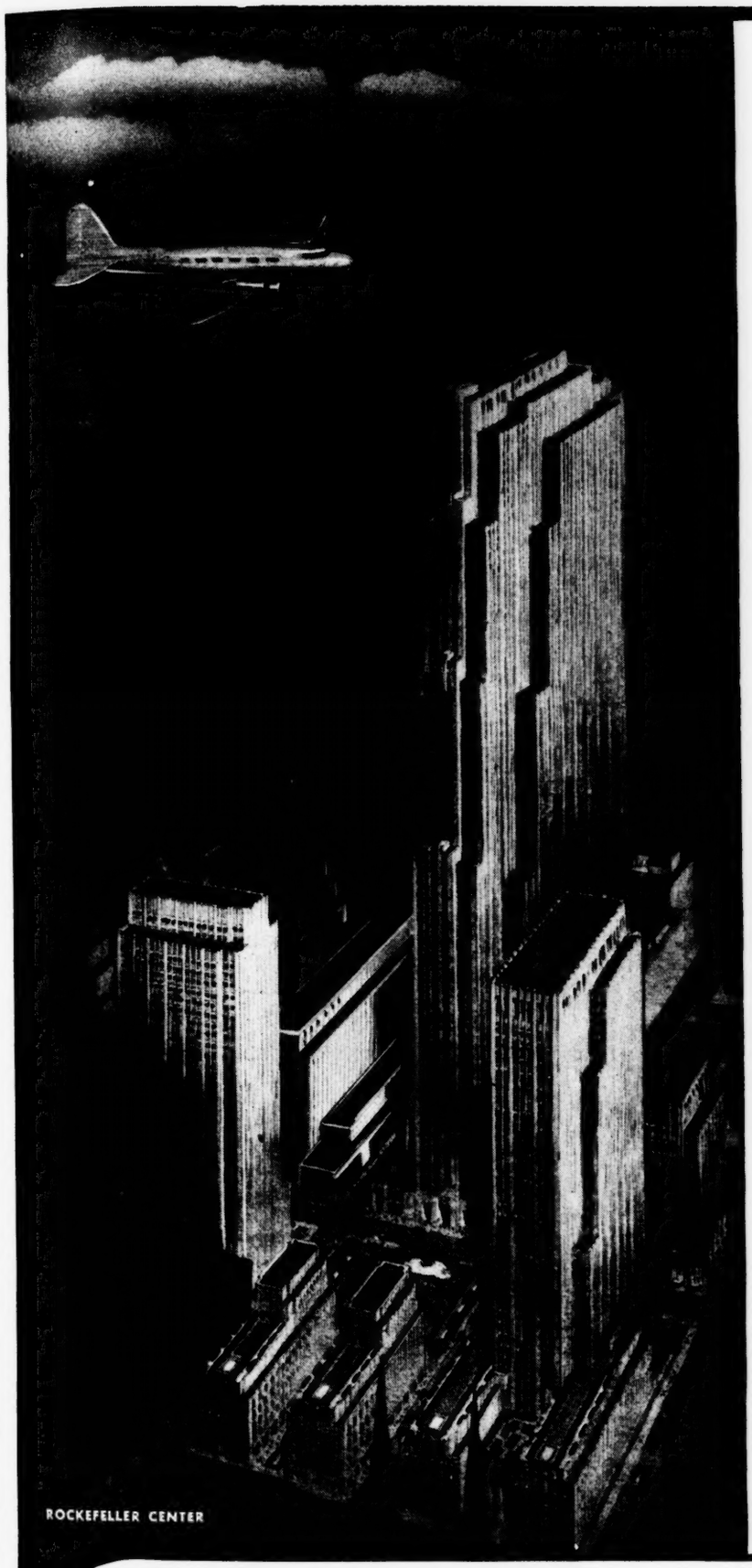
HEATING AND VENTILATING'S 16th year of publication of monthly degree-day data

City	Monthly Degree-Days			Cumulative Degree-Days[1]			Year[2]
	Degree-Days, April, 1944	Degree-Days, April, 1943	Degree-Days, April, Normal	Season, 9/1/43-4/30/44	Season, 9/1/42-4/30/43	Season, Normal, 9/1-4/30	Normal, 9/1-8/30
Lansing, Michigan	696	718	582	7003	7047	6819	7048
Lewiston, Maine	757	776	693	7813	7560	7318	7707
Lincoln, Nebraska	581	343	417	5968	5874	5900	5999
Little Rock, Arkansas	152	126	78	3095	3044	2811	2811
Livingston, Montana	632	449	653	6466	6672	6638	7205
Los Angeles, California	184	130	159	1309	1081	1414	1504
Louisville, Kentucky	283	371	264	4317	4458	4180	4180
Lynchburg, Virginia	279	339	273	3931	3859	3980	3980
Macon, Georgia	140	127	33	2363	2243	2201	2201
Madison, Wisconsin	672	624	582	7073	7488	7193	7429
Marquette, Michigan	849	863	804	7724	8198	7968	8693*
Memphis, Tennessee	179	161	96	3204	3157	2950	2950
Meridian, Mississippi	118	87	24	2357	2179	2160	2160
Milwaukee, Wisconsin	733	671	648	6993	7269	6856	7245
Minneapolis, Minnesota	659	621	570	7424	8229	7614	7850
Modena, Utah	662	424	579	6334	5527	6170	6562
Montgomery, Alabama	98	76	0	2041	1922	1884	1884
Nantucket, Massachusetts	631	694	639	5486	5598	5450	5957
Nashville, Tennessee	241	252	180	3666	3622	3507	3507
New Haven, Connecticut	601	647	543	5973	5755	5672	5895
New Orleans, Louisiana	40	21	0	1232	1205	1024	1024
New York, New York	509	589	486	5271	5146	5192	5347
*Nome, Alaska	1816	1667	1756	10084	10801	10642	14580**
Norfolk, Virginia	247	309	246	3420	3158	3350	3350
North Head, Washington	494	467	516	3916	4111	4271	5452**
North Platte, Nebraska	618	345	486	6255	5773	6167	6366
Oakland, California	362	271	273	2650	2532	2665	3143**
Oklahoma City, Oklahoma	229	93	162	3612	3454	3613	3613
Omaha, Nebraska	568	349	414	6238	6124	6047	6131
Oswego, New York	760	835	675	6914	6900	6668	7088
Parkersburg, West Virginia	381	488	351	5005	4858	4722	4775
Peoria, Illinois	529	488	453	6137	6109	5988	6109
Philadelphia, Pennsylvania	440	521	402	4801	4799	4787	4855
Phoenix, Arizona	51	41	0	1519	1013	1405	1405
Pittsburgh, Pennsylvania	449	560	423	5330	5195	5157	5235
Pocatello, Idaho	640	378	567	6689	5981	6263	6655
Portland, Maine	780	804	666	7417	7409	6771	7218
Portland, Oregon	372	286	402	3775	3784	4134	4469
Providence, Rhode Island	566	632	558	5690	5755	5764	6015
Pueblo, Colorado	633	267	456	5814	4919	5328	5514
Raleigh, North Carolina	205	238	183	3423	3181	3234	3234
Rapid City, South Dakota	676	442	594	6967	6950	6744	7118
Reading, Pennsylvania	473	556	417	5267	5219	5293	5389
Redding, California	306	181	156	2570	2456	2451	2451
Reno, Nevada	635	430	534	5641	4865	5436	5892
Richmond, Virginia	270	343	246	3917	3747	3695	3695
Rochester, New York	745	793	618	6927	6853	6472	6732
Roseburg, Oregon	431	315	411	3903	3527	4047	4428
Roswell, New Mexico	223	86	180	3606	2896	3484	3484
Sacramento, California	276	174	207	2524	2433	2600	2653
St. Joseph, Missouri	488	300	342	5456	5326	5145	5161
St. Louis, Missouri	343	312	276	4623	4583	4585	4585
Salt Lake City, Utah	533	283	453	5940	5195	5319	5555
San Antonio, Texas	27	6	0	1671	1408	1202	1202
San Diego, California	164	122	174	1284	1083	1524	1645
Sandusky, Ohio	617	643	726	5933	6010	6025	6208
San Francisco, California	354	282	294	2199	2222	2417	3264**
Sault Ste. Marie, Michigan	881	947	819	8396	7419	8448	9285**
Savannah, Georgia	73	80	0	1528	1556	1490	1490
Scranton, Pennsylvania	604	708	513	6260	6199	5958	6129
Seattle, Washington	398	341	462	3839	4009	4379	4934**
Sheridan, Wyoming	574	393	648	6906	6844	7485	8008
Shreveport, Louisiana	79	50	0	2224	2106	1938	1938
Sioux City, Iowa	620	465	489	6849	7002	6734	6898
Spokane, Washington	512	438	504	5893	6055	5989	6355
Springfield, Illinois	427	393	366	5353	5376	5317	5373
Springfield, Missouri	386	293	267	4742	4569	4416	4428
Syracuse, New York	715	796	630	7008	6944	6614	6893
Tacoma, Washington	434	382	465	4253	4312	4551	5181**
Terre Haute, Indiana	383	410	333	5130	5171	4872	4872
Toledo, Ohio	654	668	525	6480	6368	5897	6077
Topeka, Kansas	446	237	300	5067	4916	4935	4969
Trenton, New Jersey	482	568	402	5273	5207	4852	4933
Utica, New York	726	810	588	7434	7188	6543	6796
Valentine, Nebraska	699	416	561	7071	6806	6766	7039
Walla Walla, Washington	365	294	363	4835	4680	4637	4808
Washington, D. C.	342	414	348	4441	4303	4601	4626
Wichita, Kansas	398	187	252	4695	4653	4673	4673
Williston, North Dakota	644	531	669	7821	8979	8907	9323
Winnemucca, Nevada	623	370	539	6055	5127	5950	6427**
Yakima, Washington	394	318	360	5214	5422	5413	5599

*Includes August. **Includes July and August.

[1]Cumulative data identical with monthly figures for September only. In subsequent months, cumulative figures will show record for whole heating season to and including month in question.

[2]Figures in this column are normal totals for a complete heating season, September to June, incl.



ROCKEFELLER CENTER

High-Altitude HEATING
FOR BUILDINGS

The engineering strides made in war-time high-altitude operations place new emphasis on High-Altitude Heating which has been serving many of America's finest buildings for almost 20 years.

A Dunham Differential Vacuum Heating System, by means of various "altitudes"—or more exactly, sub-atmospheric pressures—automatically raises or lowers the temperature of the steam being circulated, thus balancing the heat supply with the heat loss of the building. This results, not only in *unvarying* room temperatures regardless of weather changes, but in an appreciably important conservation of fuel—a problem which confronts the Nation now, as never before, in the interests of unfailing supplies for our Armed Forces.

Fuel conservation will be a dominant requirement after the "duration" and this is the moment to consider Dunham Differential Heating for post-war building. Vast housing projects are already "on the boards" of architects and engineers for release when Victory is in our hands. For such huge undertakings only Dunham High-Altitude Heating will prove satisfactory in economy, in performance, in low upkeep cost and in ease of maintenance. No large building management can justifiably ignore these factors.

MAY WE MAIL YOUR COPY?

May we send you a new Brochure on High-Altitude Heating which explains and describes the system together with performance data on outstanding buildings.

BUY WAR BONDS AND KEEP THEM

DUNHAM *makes fuels go further*

C. A. DUNHAM CO., 450 E. OHIO ST., CHICAGO 11, ILL.
Toronto, Canada *London, England*

WITH THE MANUFACTURERS

WORTHINGTON PUMP AND MACHINERY CORP.

Harrison, N. J., has purchased Electric Machinery Manufacturing Co., Minneapolis, Minn. Second important acquisition by Worthington within a year, Electric Machinery's major lines of synchronous motors for direct drive for a wide variety of power plant and industrial machinery, as well as electric generators for steam and internal combustion engines, provide a logical extension of Worthington's already large power and industrial equipment lines. Electric Machinery will continue to operate independently of the other Worthington activities. Its present executive personnel, Walther H. Feldmann, president; O. A. Soderstrom, vice-president in charge of manufacturing; R. H. Olson, vice-president in charge of sales; and Fred W. Hotchkiss, secretary and treasurer, will continue in those capacities.

CARRIER CORP.

Syracuse, N. Y., has appointed William A. Haile manager of its International Division's Washington offices. A veteran of United States export trade, engaged for a number of years in foreign sales of industrial machinery, Mr. Haile will leave the Diesel engine division of WPB to join Carrier. Colin McCulloch has been named market research manager on Heman Greenwood's staff at Syracuse headquarters.

AMERICAN MACHINE AND METALS, INC.

East Moline, Ill., announces that John C. Vander Pyl, vice-president for the past four years and operating officer at the company's plant in East Moline since 1941, has been named executive vice-president. Wayne Mendell, general sales manager since 1940, is named vice-president in charge of sales. Mr. Vander Pyl joined the company in 1931 as factory office manager. In 1936, he was elected secretary of the corporation and was made vice-president in 1940 following his election to the board of directors. Mr. Mendell became connected with the company in 1939 and was appointed general sales manager the following year with headquarters at the company's offices in East Moline.

H. C. LITTLE BURNER CO.

Midwest Division have moved their offices from Aurora, Ill. to 32 S. Jefferson St., Chicago, effective June 1. Mr. Ken Swift continues as District Representative.

THE BRISTOL COMPANY

has opened a new branch office in Houston, Tex. The new office will be located in the Citizens State Bank Building and will serve the states of Louisiana and Texas with the exception of the Panhandle section. D. D. Ault who has been resident sales engineer in Houston for the company for a number of years will be in charge of the new office.

ALLEN-BRADLEY CO.

of Milwaukee, Wis., has moved its New York offices to 155 East 44th St., New York 17, N. Y. The new telephone number is Murray Hill 2-7142. C. N. Calkins remains in charge as New York district manager.

AIRTEMP DIVISION, CHRYSLER CORP.

has appointed William C. Stoner, who formerly operated Chrysler Airtemp dealerships in Illinois and Indiana, as Airtemp district representative, with headquarters in Atlanta.

BAILEY METER COMPANY

has announced that E. G. Bailey, former president and company founder, has been elected chairman. Robert S. Coffin succeeds him as president. Mr. Coffin, who has been vice-president since 1925, was company treasurer at the time of its organization in 1916. Other officers elected are, R. E. Woolley, vice-president, who has served in that capacity since 1927, and J. H. Black, secretary-treasurer.

MINNEAPOLIS-HONEYWELL REGULATOR CO.

Harry C. Jenkins

has formed a new division to manufacture and market its recently announced Moduflow heating control system. Harry C. Jenkins, formerly midwestern zone manager, has been promoted to managership of the newly-created post, while a nucleus of a sales organization has been started by the addition of three specialists to the staff. Applicable to all types of heating systems in present, as well as postwar houses, Moduflow will not be placed on the market until after victory or until materials are made available. Assisting Mr. Jenkins in his new position are three engineers who will work for the present in the Minneapolis and Chicago offices of the company. They are John E. Peterson, Milford G. Bird and Bruce F. McLouth. Starting with the company as a salesman in June, 1921, Mr. Jenkins first sold damper controls before fully automatic heating systems became widespread. He later was the company's sales manager in Minneapolis and St. Paul, and Twin City Branch Manager before assuming his duties as zone manager which position he held for five years before his latest promotion. Mr. Peterson, president of the Illinois Sheet Metal Contractors Association from 1941 to 1943, and assistant mechanical engineer for the Corps of Engineers, U. S. Army, was formerly president of the Home Heating Company, Hinsdale, Ill. He has been assigned to Minneapolis-Honeywell's Chicago office and has started work there after completing a brief technical course at the main plant.

Presently on inactive status as a lieutenant in the United States Army, Mr. Bird has joined Honeywell after serving as battalion intelligence officer, Infantry, in the South Pacific. He graduated from Chicago Technical Institute in 1934 and was associated with the heating business continuously until he entered the armed services. Mr. McLouth has been chief of the heating section, 9th Service Command, U. S. Army. Both Messrs. Bird and McLouth will make their headquarters in Minneapolis as assistants to Mr. Jenkins.

(Concluded on page 106)

Milford G. Bird (Left), John E. Peterson (Center), and Bruce F. McLouth (Right)

ANGLE FACTORS FOR RADIANT HEATING AND COOLING

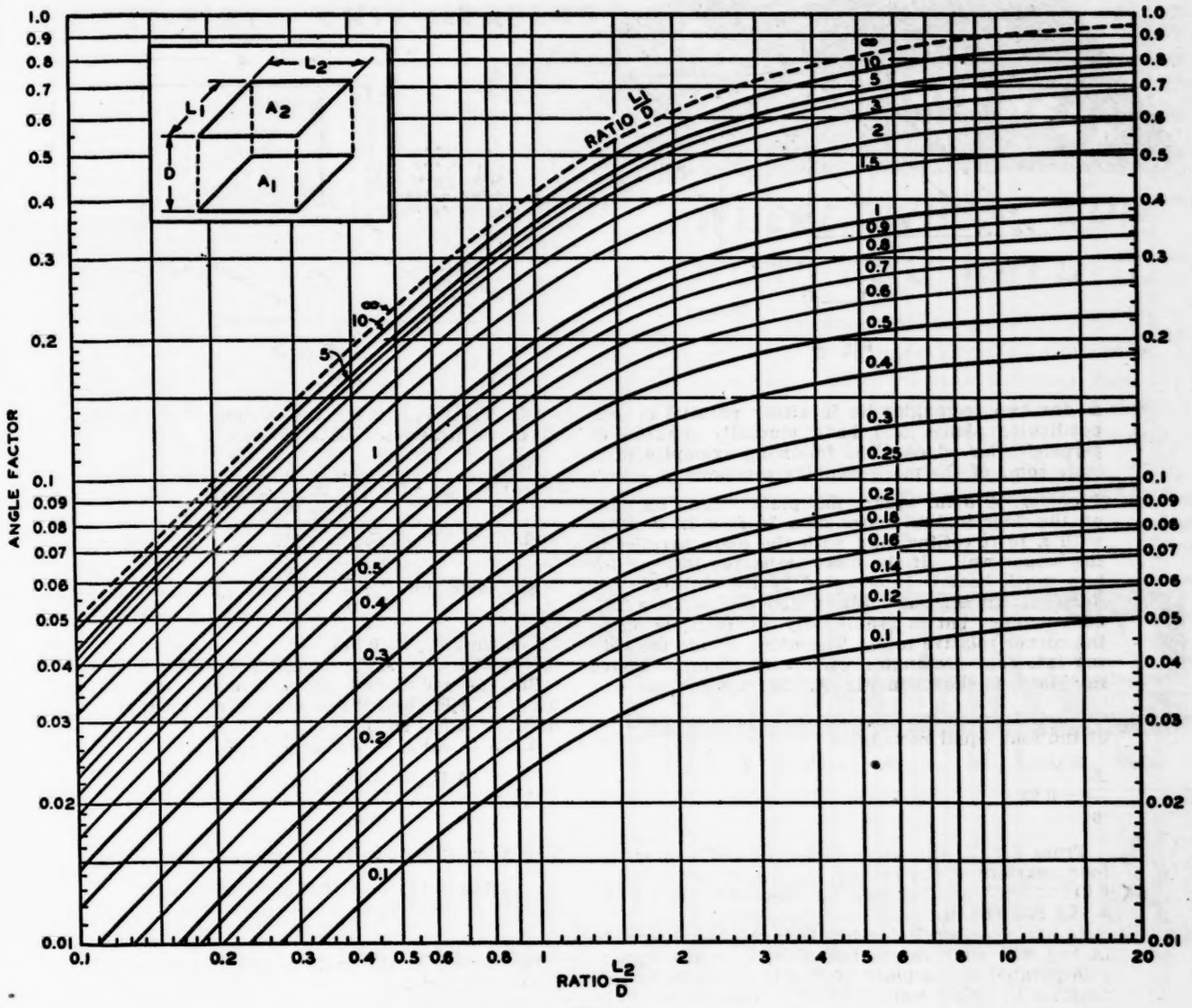


Fig. 5

Charts shown on this sheet and on preceding Reference Data 267-268 and 269-270 give the values of angle factors for radiant heating or cooling calculations. All are from a study by the College of Engineering, Cornell University, as reported in Bulletin 32 of the Cornell University Engineering Experiment Station, entitled "Radiant Heating and Cooling, Part 1," by C. O. Mackey, L. T. Wright, Jr., R. E. Clark, and N. R. Gay, and presented here by permission. Angle factor is defined on Reference Data 267-268.

The data presented on the three sheets are applicable not only to the radiant heating or cooling of rooms, but for studies of radiant heat exchange in boiler furnaces, illumination, etc. The data are applicable to more complicated *arrangements* of surfaces than shown on this and the two subsequent sheets, but not for more complicated surfaces.

Fig. 5 on this sheet covers the case where the emitting area A_1 is a sphere, quite small in area relative to the absorbing area A_2, and where a normal from a corner of A_2 passes through the center of the sphere. In Fig. 5 L_1 and L_2 are interchangeable.

USE OF CHART

Problem: A 3 in. diameter sphere emitting 400 Btu per hr is located 2 ft from the floor in the corner of a room 15 ft x 24 ft in plan and with a 12 ft ceiling. How much heat is intercepted by the ceiling?

Solution: Referring to Fig. 5, since the sphere is 2 ft from the floor, D = 10, and

$$\text{Ratio } \frac{L_2}{D} = \frac{24}{10} = 2.4; \quad \frac{L_1}{D} = \frac{15}{10} = 1.5.$$ From Fig. 5, angle factor is 0.068. The ceiling intercepts 400 x 0.068 = 27.2 Btu per hr.

MORE COMPLEX EXAMPLES

This series of charts (Reference Data 267-268, 269-270 and 271-272) can be used for quite complicated arrangements of rectangular surfaces as long

Published by Heating and Ventilating, *148 Lafayette St., New York.* 6/44. *Copyright, 1944, by* The Industrial Press.

ANGLE FACTORS FOR RADIANT HEATING AND COOLING

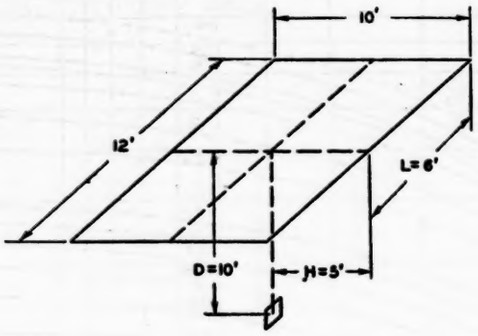


Fig. A

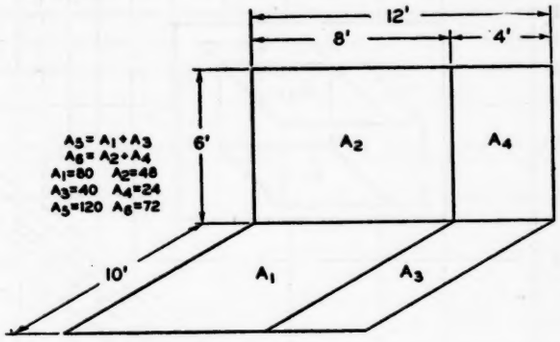


Fig. B

as the two rectangles lie in either parallel or perpendicular planes and have mutually parallel or perpendicular edges. The following examples illustrate some of the more complex problems.

Problem: A 3 in. square flat plate stands on edge on the floor in the center of a 10 ft x 12 ft room with a 10 ft ceiling, and with the plate parallel to the longer wall. If the plate emits 100 Btu per hr, how much heat is intercepted by the ceiling?

Solution: In this case Fig. 2 (Reference Data 267-268) applies, but is usable only where A_1 is off to the corner relative to A_2. Therefore, divide the ceiling into four rectangles, each with a corner above the plate, as shown in Fig. A. Solving for any one of the four equal rectangles, $\frac{D}{L} = \frac{10}{6} = 1.67$; $\frac{H}{L} = \frac{5}{6} = 0.83$.

From Fig. 2, the angle factor is 0.017. For the four quarters of the ceiling, the angle factor is 4 x 0.017 = 0.068, and the heat intercepted is 100 x 0.068 = 6.8 Btu per hr.

As explained on Reference Data 267-268, L and H in Fig. 2 are not interchangeable; L is the dimension parallel to the plane of A_1. If in the foregoing example the plate were parallel to the shorter wall, $F_{1\text{-}2}$ would have been 0.076 instead of 0.068.

Example: Consider Fig. B, where A_1 and A_3 represent the floor, A_2 and A_4 the side wall. The problem is to find the angle factor of A_1 to A_4.

Solution: Let $A_5 = A_1 + A_3$ and $A_6 = A_2 + A_4$.

Then (see Fig. 4) $\frac{L_2}{W} = \frac{6}{12} = 0.50$ and $\frac{L_1}{W} = \frac{10}{12} = 0.83$. Then $F_{5\text{-}6}$ (using the system of nomenclature given on Reference Data 267-268) = 0.17.

In the case of $F_{1\text{-}2}$ $\frac{L_2}{W} = \frac{6}{8} = 0.75$, $\frac{L_1}{W} = \frac{10}{8} = 1.25$

and, from Fig. 4, $F_{1\text{-}2} = 0.152$.

Similarly, for $F_{3\text{-}4}$ $\frac{L_2}{W} = \frac{6}{4} = 1.5$ and $\frac{L_1}{W} = \frac{10}{4} =$ 2.5 so that $F_{3\text{-}4} = 0.113$.

Now $A_5F_{5\text{-}6} = A_3F_{3\text{-}4} + A_3F_{3\text{-}2} + A_1F_{1\text{-}2} + A_1F_{1\text{-}4}$.

But, as mentioned on Reference Data 267-268, $A_3F_{3\text{-}2} = A_2F_{2\text{-}3}$ and it can also be shown that $A_2F_{2\text{-}3} = A_1F_{1\text{-}4}$ so that

$A_5F_{5\text{-}6} = A_3F_{3\text{-}4} + A_1F_{1\text{-}2} + 2A_1F_{1\text{-}4}$ and

$$F_{1\text{-}4} = \frac{A_5F_{5\text{-}6} - A_3F_{3\text{-}4} - A_1F_{1\text{-}2}}{2A_1}$$

Now $A_5 = 120$, $A_3 = 40$, $A_1 = 80$, so that

$$F_{1\text{-}4} = \frac{120\ (0.17) - 40\ (0.152) - 80\ (0.113)}{2 \times 80} = 0.0328$$

The answer to the problem is thus 0.0328. If it is desired to find $F_{5\text{-}4}$,

$A_6F_{6\text{-}5} = A_4F_{4\text{-}3} + A_4F_{4\text{-}1}$

$A_5F_{5\text{-}4} = A_3F_{3\text{-}4} + A_1F_{1\text{-}4}$

$$F_{5\text{-}4} = \frac{A_3F_{3\text{-}4} + A_1F_{1\text{-}4}}{A_5}$$

$$F_{5\text{-}4} = \frac{40\ (0.113) + 80\ (0.0328)}{120} = 0.0595$$

Published by Heating and Ventilating, *148 Lafayette St., New York.* 6/44. *Copyright, 1944, by* The Industrial Press.

DIRECTHERM

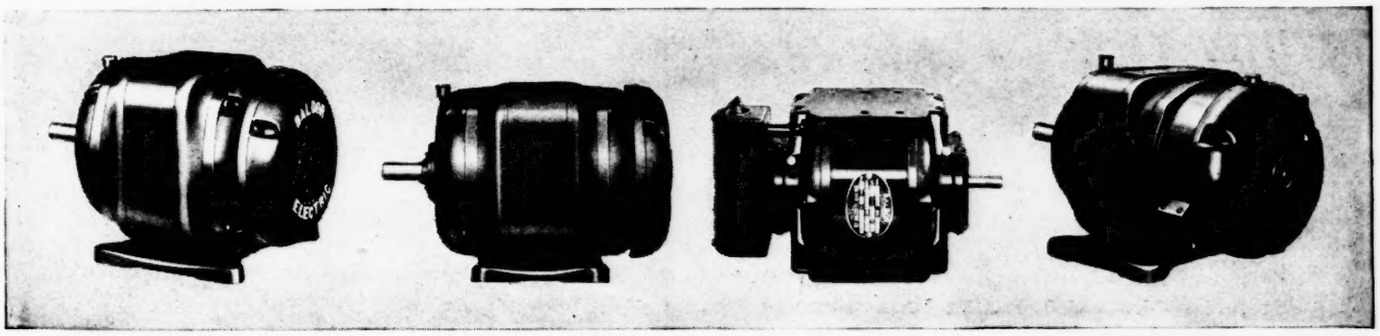
DIRECT-FIRED UNIT HEATERS

WHERE, WHEN, AND HOW YOU NEED IT

For permanent or temporary, for additional or emergency heating. Can easily be moved to other rooms or buildings. Automatic controls prevent heat-wastage. Direct heat outlets save fuel. Powerful blower spreads heat evenly without draft. May we give you detailed information on this flexible and economic way of heating?

AIRTHERM MANUFACTURING CO.

722 S. Spring Ave., St. Louis, Mo.



BALDOR glass-insulated motors are used for all applications; especially recommended where limited space and weight is a factor.

BALDOR totally enclosed motors, STREAMCOOLED DESIGN, available in 1 ph., 3 ph. and D. C.

BALDOR fan and blower motors, gimbal-mounted, assure Quiet Operation.

Fully compensated D.C. motors; available in standard and low voltage for truck, railway and traction service.

BALDOR face-mounted vertical motors; totally enclosed STREAMCOOLED DESIGN; 1 ph., 3 ph. and D. C.

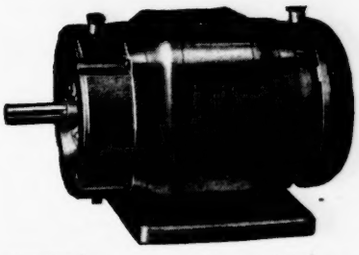
BALDOR
BETTER MOTORS

Regardless of mechanical specifications and current characteristics required, Baldor is qualified by experience to handle your motor problems. The complete Baldor line includes all types of motors 1/20 to 20 H. P.

BALDOR ELECTRIC COMPANY, ST. LOUIS 10, MO.

District Offices in Principal Cities

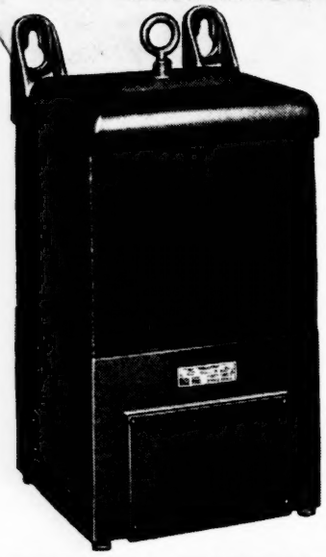
25th YEAR of engineering service to motor buyers



BALDOR face-mounted horizontal motors; totally enclosed, STREAMCOOLED DESIGN; 1 ph., 3 ph. and D. C.

It's to YOUR Advantage to use

Wagner Air-Cooled TRANSFORMERS



Because they are—

Safe for either indoor or outdoor installation.

Compact and easy to install.

Usable right at load.

STUDY THESE FEATURES:

1. Dry-type... no liquid.

2. Core and coils are vacuum treated in compound for protection against moisture.

3. Totally enclosed.

4. Provided with built-in junction box with knockouts on sides and bottom for conduit or open wiring.

5. Large removable coverplate of junction box assures ease in making connections.

6. Hanger-lugs designed for ease in mounting.

7. All ratings within the limits of the National Board of Fire Underwriters have the Underwriters' approval.

MOTORS
TRANSFORMERS
UNIT SUBSTATIONS
INDUSTRIAL BRAKES
BRAKE LINING

T44-10A

Write FOR COMPLETE LITERATURE

ARMY E NAVY

NATIONAL SECURITY AWARD

Wagner Electric Corporation
ESTABLISHED 1891
6462 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

(Concluded from page 104)

BROWN INSTRUMENT COMPANY

has elected Paul L. Goldstrohm and George M. Muschamp members of the board of directors. Mr. Muschamp is vice-president in charge of engineering of the Brown company, a division of Minneapolis-Honeywell Regulator Co., and Mr. Goldstrohm is vice-president in charge of production.

LINK-BELT COMPANY

Caldwell Plant, 2410 West 18th St., Chicago (8), announces that F. H. Herndon has been appointed manager of the company's Coal Stoker Division, in full charge of its activities and personnel, with headquarters at the Caldwell plant. Mr. Herndon has been assistant manager for the last 10 years. K. C. Ellsworth, heretofore eastern stoker division manager at New York, has been appointed sales manager of the stoker division, with headquarters at the Caldwell plant. Mr. Herndon came to Link-Belt Company from the Modern Coal Burner Co. in 1934, when Link-Belt acquired the automatic stoker business and stock of parts of this subsidiary of the Peabody Coal Co. He had started with the Peabody organization in 1918, later serving as a traveling auditor, and for two years having been general superintendent for Modern Coal Burner Co. Mr. Ellsworth has been through practically every phase of selling in the Link-Belt stoker division, joining it in 1934, after having been the company's stoker dealer in Erie, Pa.

K. C. Ellsworth

F. H. Herndon

L. J. WING MFG. CO.

has appointed the following new sales representatives: William H. Neville, Birmingham, Ala.; Johnson & Scott, Memphis, Tenn.; and Richard Barthelmess Sales Co., Jacksonville, Fla.

DRESSER MFG. CO.

has announced the election of three vice-presidents of the company following a recent meeting of the board of directors. J. B. O'Connor has been elected executive vice-president. Arthur R. Weis and Lyle C. Harvey have been elected vice-presidents. Mr. Harvey is president of the Bryant Heater Company of Cleveland, a subsidiary.

MINNEAPOLIS-HONEYWELL REGULATOR CO.

has appointed G. M. Kingsland as refrigeration controls division manager. Mr. Kingsland, formerly of the Company's Cleveland office, has been elevated to the post following the resignation of A. B. Newton who had been refrigeration controls manager for the past five years. Lin J. Krause has been appointed assistant sales manager to Mr. Kingsland and will be attached to the home office permanently. Mr. Krause also had been attached to the Cleveland staff, where he was associated with refrigeration and air conditioning controls, but has been in Minneapolis for the past year on a temporary assignment. In Cleveland, Mr. Kingsland had been zone supervisor of Minneapolis-Honeywell's Modutrol division.

WESTINGHOUSE ELECTRIC ELEVATOR CO.

has been elected to membership in the Air Conditioning and Refrigerating Machinery Association, Inc.

PERSONALS AND PERSONNEL

ROSS RATHBUN

manager of air conditioning at the Westinghouse Electric Elevator Company, Jersey City, N. J., has announced the appointment of three men to executive positions on his staff: L. Gale Huggins was named assistant manager of air conditioning and will be general assistant to Mr. Rathbun in administration, engineering and application matters; Walter C. Goodwin becomes negotiation manager with responsibility for application engineering and negotiations, and Howard A. Blair was appointed service manager.

L. Gale Huggins *Walter C. Goodwin* *Howard A. Blair*

Mr. Huggins joined Westinghouse in 1923. When the air conditioning department was organized in East Pittsburgh in 1933 he became assistant to the department manager and application engineer, accompanied the department when it was moved to Mansfield, Ohio, in 1936, and to Springfield, Mass., in 1938, and came to Jersey City late last year when the Company's heavy air conditioning manufacturing activities were transferred to that city. Before leaving the New England plant he was active in the development of war equipment and the training of Army personnel in its uses.

Mr. Goodwin joined Westinghouse in 1915 and has been development engineer, section engineer in charge of development, liaison engineer, and, in 1933 became division engineer in the supply engineering department in charge of air conditioning. In 1936 he went to Mansfield as application engineer in the air conditioning commercial department and was later assigned to the East Springfield, Mass., Works. Mr. Goodwin was assigned to air conditioning at the Elevator Company late last year.

Mr. Blair joined Westinghouse in 1929 and has been editor of engineering material and extension courses. In 1934 he was service manager of the Metropolitan Air Conditioning Corporation in New York City. Since 1940 he was assistant to the service manager, electric appliance division, located at East Springfield, and was responsible for the servicing of all products manufactured at that plant, including air conditioning.

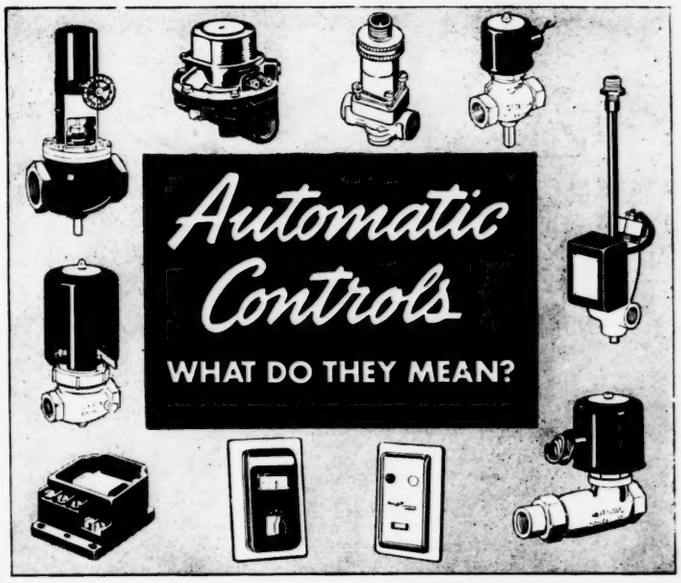
A. B. NEWTON

has been appointed staff engineer in charge of commercial refrigeration by the Airtemp Division, Chrysler Corporation. Mr. Newton was for the past eight years with Minneapolis-Honeywell Regulator Co., the last six of which were spent as the engineer of the control division. Prior to that he was with York Ice Machinery Corp., and General Electric Co.

F. G. COGGIN

has been appointed manager of the Oil Burner Controls Division of the Detroit Lubricator Co. P. S. Russel, who formerly held this position, is devoting his efforts to research and development.

(Continued on page 108)



Automatic controls of pressure, temperature and flow assure *pre-determined accuracy of results* wherever they are used. No thinking executive, production manager or maintenance engineer can miss the full significance of this statement.

In factories and plants of every size and kind, *automatic controls* increase productive output and reduce waste by simplifying operations, speeding work, and assuring uniformity of finished product. With controls, even the most inexperienced novices quickly attain proficiency.

In homes and buildings, large and small, *automatic controls* promote economy, comfort, health by providing optimum temperature and humidity, saving fuels and doctors' fees.

On stationary equipment such as presses, machine tools, internal combustion and diesel engines, *automatic controls* save materials, plumbing, space, time and money.

On moving equipment such as aircraft, ships, tractors, trucks, tanks, locomotives, hi-g *light-weight controls* assure efficient performance because they operate in any position, regardless of vibration, change of motion or acceleration. hi-g saves weight and space.

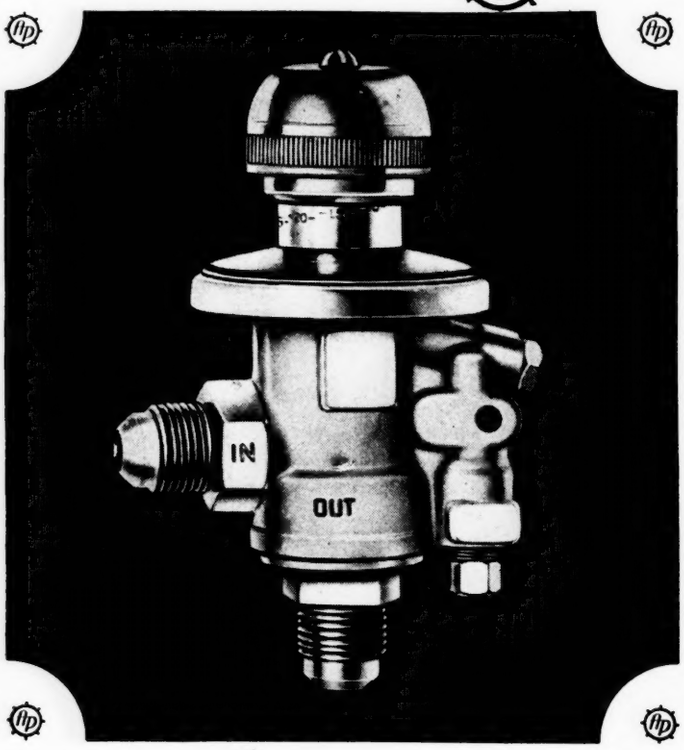
Although now engaged full-time in supplying war needs, General Controls' staff of "straight-thinking" engineers invite your request for help in solving your post-war control problems. For complete description of General Controls' broad line of automatic pressure, temperature and flow controls, write for Catalog 52.

HIGH CAPACITY AT LOW COST

V-300 Low Pressure Gas Regulators are compact, built to last. For natural, manufactured and L.P. gases. Sizes from ⅜" to 2" I.P.S. Outlet pressures from 2" to 5"; factory setting 3½" for average appliance use.

Dependability doesn't happen...

IT'S *BUILT INTO* EVERY AP VALVE



Model 235 Suction Pressure Regulating Valve

Used to regulate pressure at the tail of the evaporator, Model 235 is particularly valuable where two or more evaporators must be operated at different temperatures from a single condensing unit. Maintains evaporator temperature within close limits.

It has a graduated pressure scale, and adjusting range from 10" vacuum to 30 pounds. Furnished complete with shut-off valve for pressure recording gauge, it can be used on flooded, semi-flooded or dry expansion types, in capacities up to ½ ton Freon, or ¾ ton Methyl or Sulphur.

AUTOMATIC PRODUCTS COMPANY

2462 North Thirty-Second Street • Milwaukee 10, Wisconsin
Export Dept. — 13 East 40th Street, New York 16, New York

DEPENDABLE
REFRIGERANT VALVES

(Continued from page 107)

V. P. VICTOR

has opened a consulting engineering office at 655 Fifth Ave., New York 22, N. Y. For the past fifteen years Mr. Victor was associated with the J. O. Ross Engineering Corp., New York, specializing in drying, industrial air conditioning, refrigeration, and associated subjects. Prior to that he spent five years in the machine tool and automatic machinery field. For several years he taught evening classes in machine design and product engineering in New York schools. He is a licensed professional engineer.

FRANK EWEN BOOTH

controller of Grayson Heat Control, Ltd., Lynwood, Calif., and Edward J. Murphy, controller of The Kennedy Valve Mfg. Co., Elmira, N. Y., have been elected to membership in the Controllers Institute of America. The Institute is a technical and professional organization of controllers devoted to the improvement of controllership procedures.

DR. RAYMOND C. JOHNSON

Dr. R. C. Johnson

has been elected vice-president in charge of research for Anthracite Industries, Inc., and as such will supervise the research program now being carried on at the Anthracite Industries' laboratory at Primos, Pa. Dr. Johnson succeeds Dr. H. J. Rose who has resigned to become vice-president and director of research of Bituminous Coal Research, Inc.

Dr. Johnson has been engaged in anthracite coal research and equipment development work since 1927. Early in this period, he was associated with the U. S. Bureau of Mines and then with the Philadelphia & Reading Coal & Iron Co. as a research engineer. In 1937 he joined the staff conducting research work for Anthracite Industries, Inc., at Mellon Institute of Industrial Research. In 1941 he became director of the Anthracite Industries, Inc., Laboratory.

R. L. IRVIN

has been appointed application manager, small motor division of the Westinghouse Electric and Mfg. Co., Lima, Ohio. He was formerly industrial manager of the Company's Northwestern district with headquarters in Chicago.

JOHN M. DUMSER

has been appointed manager of Pipe and Water Tube Sales, Chase Brass & Copper Co. He has been with the company since 1927 and will continue to supervise priority and controlled materials plan work. Mr. Dumser started work at the St. Louis branch in the sales and sales promotion departments and came to Waterbury, Conn., four years ago as assistant manager of Pipe and Water Tube Sales.

RALPH H. METCALF

has been appointed by Minneapolis-Honeywell Regulator Company zone supervisor for the air conditioning controls division in the Cleveland area. For the past eight years, Mr. Metcalf has specialized in air conditioning controls, making his headquarters in the St. Louis office of the company and at the main plant here.

DR. HARVEY C. RENTSCHLER

director of research of the Westinghouse Lamp Div., has been presented with the Frank P. Brown Medal awarded annually by The Franklin Institute for his work in development and application of the Sterilamp.

D. W. RUSSELL

president, Airtemp Division, Chrysler Corporation, was elected president of the Air Conditioning and Refrigerating Machinery Association, Incorporated, in its annual meeting held at Hot Springs, Va., May 19. Other officers are S. E. Lauer of the York Corporation, first vice-president; F. S. McNeal of the Universal Cooler Corporation, second vice-president; and P. A. McKittrick of the Parks-Cramer Company, treasurer. C. E. Wilson, vice-president of the Worthington Pump and Machinery Corporation, was elected to the chairmanship of the ACRMA board of directors. In addition to the officers, the members of the Board are: W. H. Aubrey, Frick Co., Inc.; F. T. Goes, The Vilter Mfg. Co.; G. A. Heuser, Henry Vogt Machine Co.; E. T. Murphy, Carrier Corp.; Harry Newcomb, Servel, Inc.; J. P. Rainbault, General Electric Co., Ross Rathbun, Westinghouse Electric Elevator Co.; H. R. Sewell, B. F. Sturtevant Co.; and G. E. Wallis, The Creamery Package Mfg. Co. Mary Jane Stewart continues as secretary of the Association.

JOHN D. BEEBE

has been named manager of a new department, rubber suspension sales, it is announced by The B. F. Goodrich Company. The new department will have charge of sales of the company's Torsilastic rubber springs and its line of Vibro-Insulators, made of rubber and metal primarily for the elimination of vibration, and devices for sound dampening. Mr. Beebe joined the company in 1923 as a salesman of industrial rubber products in the Denver district, has been in sales posts in the industrial products division at Akron headquarters since 1928.

ED. CRANE

has been appointed industrial sales engineer in the Buffalo area for the Brown Instrument Co., Philadelphia, precision industrial instrument division of Minneapolis-Honeywell Regulator Co. Mr. Crane has been transferred from the New York City office. He will include the northwest section of New York State in his territory.

J. NEIL BROPHY

after six weeks spent at the main offices and plants of Enterprise Engine and Foundry Company, San Francisco, will represent the engine division of Enterprise covering the New England States out of the company's New York offices.

JOHN L. MAHONEY

formerly of Philip H. Harrison & Company, northern New Jersey, distributors for General Electric Company, has joined the staff of Carrier Corporation. Mr. Mahoney will be affiliated with applied refrigeration.

HARRY R. WINKLE

Owens-Corning Fiberglas Corporation comptroller and treasurer, has been elevated to the post of vice-president. This action was taken at a recent meeting of the corporation's board of directors in recognition of "the increased importance of the financial phase of the business." Mr. Winkle will continue to serve as comptroller and treasurer, a post he has held since the Fiberglas Corporation was formed November 1, 1938. He has been associated with Owens-Corning and predecessor companies since 1923. Mr. Winkle is a member of the board of directors of the Fiberglas Corporation.

Harry R. Winkle

PREVENT

Rust·Scale·Dirt

FROM CLOGGING STEAM EQUIPMENT

YARWAY STRAINERS

"The Screen's the Thing"

- *A High Grade Monel Woven Wire Basket* with mesh fine enough to catch the dirt — yet ample free area for passage of clean condensate, oil and other fluids.
- *Body Cadmium Plated Inside and Out for Protection Against Corrosion.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Over 100 Mill Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 Lbs.*

See Your Supply House or write for Bulletin S-200

YARNALL-WARING COMPANY

104 MERMAID AVENUE • PHILADELPHIA 18, PA.

YARWAY STRAINERS

Our Fighting Boys Need Water...

Designers of the famous "Water Buffalos"

IT TAKES a lot of things, like bullets, bombs, bayonets, bazookas — and *water*, to win a war. Cool, fresh drinkable water in abundance. *Peerless Pumps* at the fighting fronts keep canteens filled — and keep our fighting men fit!

Ever since Pearl Harbor, the building of *Peerless Pumps*, like the building of the justly famous "Water-Buffalo" Amphibian Tanks (also Peerless designed), has been an essential *War Industry.*

Even in the days before the war, Peerless was producing *more* Deep Well Turbine Pumps than any other concern in America. As the leading manufacturer in the Industry, Peerless won recognition throughout the entire civilized world. On the great ranches, farms, orchards and irrigation projects. In the waterworks of our great cities. In the vast industrial plants. Wherever water is needed, there you find dependable *Peerless Pumps*, operating twenty-four hours per day, year in and year out. . . Now that we are meeting the tremendous war-front demand for Pumps, we hope to be able to start "digging in" on our huge backlog of orders for home needs.

PEERLESS PUMP DIVISION—Food Machinery Corporation
1250 Camden Ave., S.W., Canton 6, Ohio
301 W. Ave. 26, Los Angeles 31, California
OTHER FACTORIES: San Jose 5, and Fresno 16, California

HI-LIFT and TURBINE TYPES

2 to 30,000 G. P. M.

PEERLESS
Deep Well Pumps

Getting Personal

Capt. B. S. Malin

Capt. B. S. Malin, now detailed for special training, Corps of Engineers, Ft. Belvoir, Va., received his B.S. from M.I.T. in 1934. This was followed with other studies at the University of Michigan.

For the next four years he had various positions as designer and at construction work in the air conditioning and refrigerating fields.

During the period 1938-1941 he served as associate mechanical engineer and mechanical inspector with the U. S. Department of Agriculture, Bureau of Engineering. He had charge of the air conditioning design for 5 large research laboratories that required special temperature control.

After being called to active army duty he was assigned as Assistant to the Works Manager, Springfield, Mass., Armory. A small arms plant had to be brought up from peacetime operation to war demands. This brought about problems in temperature control, ventilation, exhaust, dust collecting and acoustics.

See his article, Dust Collecting System in Gunstock Plant, page 51.

M. E. Ringquist

Since acquiring his mechanical engineering degree from the University of Illinois in 1936, **M. E. Ringquist** (Ventilation for Welding Booths, page 62) has received a general all around background in heating and ventilating.

Following graduation, he spent the next 2½ years with Deere & Co., as a ventilation and dust control engineer. For the next five years, he served as sales engineer in the Convector Department of The Trane Co., LaCrosse, Wis.

Proving that there is always a chance for a return engagement, Mr. Ringquist is now back with Deere & Co., as mechanical engineer in the Power Department. He is working with problems in the field of power plant work, heating, lighting, and ventilation in war production work and in the manufacture of critical farm implements.

Fitzgibbons Boiler Company, Inc., 101 Park Ave., New York 17, N. Y. (2nd Award)

Kennedy Valve Mfg. Co., Elmira, N. Y. ("M" Award)

Crocker-Wheeler Electric Manufacturing Co., Division of Joshua Hendy Iron Works, Ampere, N. J. ("M" Award)

SCOTCH MARINE BOILERS

The James Leffel & Co., Springfield, Ohio

A standard size, 28-page bulletin 236, devoted to the company's Scotch marine boilers and underfeed stokers, and including complete descriptions, photographs, cross sections, and other information on 200 hp boilers, Scotch marine portable boilers, and Scotch marine type boilers, and similar information for the company's automatic underfeed stoker, intended for internally fired, return tubular, or Scotch marine type portable boilers.

HOT WATER HEATERS

Kewanee Boiler Corp., Kewanee, Ill.

A 4-page, standard size, loose-leaf-punched folder entitled "Tabasco", on welded hot water heaters and giving descriptive information, size and capacity data, information on grates, and pipe connections.

AXIAL FLOW FANS

Aerovent Fan Co., Piqua, Ohio

The 10th edition of the company's handbook on Aerovent Macheta Airfoil fans is standard size, contains 52 pages in color, giving performance data, illustrations, application data on the company's 2-blade direct-connected, 4-blade direct connected, 6-blade direct connected fans; tubular construction fans, large propeller fans, extension shaft fans, belted fans, duct fans, main cooling fans, pulley fans, automatic shutters, and roof ventilators. Includes engineering data.

WELDING

Air Reduction Sales Co., 60 East 42nd Street, New York 17, N. Y.

A twenty-page, revised price list, "Gas and Electric Welding Supplies and Accessories." This list supersedes similar previous lists. The products in the revised list include gas welding rods made in a wide range of metals, types and sizes for all welding requirements. Other products listed and described are hard-facing alloys, brazing alloys, fluxes, helmets, goggles, gloves, aprons, welding cable, cable lugs and ground clamps. In addition to prices, the contents include detailed information of assistance to buyers, such as: sizes, dimensions, weights, stock numbers, forwarding data and recommended uses for products.

Copies of this revised price list can be obtained by writing to the main office or to any of their many branch offices and authorized distributors.

HEAT EXCHANGERS

Niagara Blower Company, 6 E. 45th St., New York 17, N. Y.

A 4-page, standard size, loose-leaf-punched folder devoted to the Niagara Aero heat exchangers with balanced wet bulb temperature control and intended for constant and accurate control of temperature in liquids or gases.

INSTRUMENTS

Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.

A standard size bulletin No. 2929 devoted to Alnor instruments for foundry service and covering company's pyrometers, thermocouple, contact pyrometer, and other instruments including the Velometer, for providing accurate measurements in foundries.

(Concluded on page 112)

DO YOU KNOW HOW EASY
— AND PROFITABLE —
IT IS TO SELL CLASS "A"
FREEMAN STOKERS RIGHT
NOW!

● Now . . . more than ever before . . . apartments, stores, factories, schools, etc. need stokers to conserve vital fuel and save labor! These prospects have the money and they're ready to buy. You will find it easy . . . *and profitable* . . . to sell them Freeman. Only one simplified form to fill out for W.P.B.; no installation problems if you take advantage of Freeman diagrams and engineering assistance; and no follow-up service troubles thanks to Freeman's rugged construction and time-proved efficiency of operation. Go after this business now. Freeman is one of the pioneers of the stoker industry and one of the leaders in national sales volume! Inquire about your territory . . . today!

FREEMAN
COMMERCIAL AND INDUSTRIAL
STOKERS
FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS

FREEMAN STOKER DIVISION, ILLINOIS IRON & BOLT CO. • 918 SO. MICHIGAN AVE., CHICAGO 5, ILL.

Motoco
Thermometer
Indicating
Model F-1
$20.
Shown with capillary tubing for remote reading.

You Benefit 4 Ways with MOTOCO

INDICATING THERMOMETERS

1. Absolute accuracy of temperature indication...

2. No intricate mechanism to get out-of-order...

3. Low cost, due to specialization and large-scale production...

4. Remote reading—temperature observation can be made at some distance from where temperatures are taken.

These four features recommend Motoco *Indicating Thermometers for use wherever uniform temperature is required in heating or cooling. Write for full information on money-saving, time-saving* Motoco *temperature indication.*

Illustrated here are two of the many types of Motoco *precision instruments made for specific industrial applications. Left: Combination Thermometer, Pressure and Altitude Gauge. Right: Pressure Gauge used in oxy-acetylene welding.*

THE ELECTRIC AUTO-LITE COMPANY
MOTO METER GAUGE AND EQUIPMENT DIVISION
CHRYSLER BUILDING, NEW YORK 17, N. Y.

In addition to a wide range of thermometers and gauges, Moto Meter specializes in the production of instruments of special design for use as a standard part of manufacturers' equipment.

(Continued from page 111)

BAFFLES

The Ramtite Co., Div. of The S. Obermayer Co., 2563 West 18th Street, Chicago 8, Ill.

Bulletin, "Economy Boiler Baffles," explains and illustrates how significant economy can be effected by proper design of baffles in furnaces. Presents blueprints showing the old and new location of baffles together with an account of savings made in each case.

COMBUSTION CONTROLS

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Penn.

Devoted to the company's new system of combustion control designed especially for the smaller industrial or municipal power plant, a catalog N-01P-163, has been issued. Publication shows how system regulates fuel-feed and draft by an electrical balance, varying settings of valves, dampers or vanes in proportion to steam demand. At same time, furnace pressure is automatically regulated. Application of this system to different types of boilers is shown by schematic illustrations. Several typical installations are pictured. The electrical balance action and control of furnace pressure are shown by photo-diagrams.

V-BELTS

The B. F. Goodrich Company, Akron, Ohio.

A 4-page folder on its line of V-belts, featuring information about its recently announced wire grommet type. The wire grommet V-belt is a development of the company, in which twin cores of endless steel wire twisted on itself form the grommets, which are kept at a uniform distance from the sides of the belt throughout its length. The grommets are covered with counter-balancing and insulated cord. The grommet type V-belt is being furnished on special jobs where it has been decided by belting engineers that standard belting cannot be used.

PUMPS

Worthington Pump and Machinery Corporation, Harrison, N. J.

Four standard size, loose-leaf-punched folders: Bulletin W-321-B-14B, devoted to single stage Monobloc centrifugal pumps for general water service, cooling towers, boiler feed, condensate, and circulation systems; Bulletin W-321-B15, covering Monobloc centrifugal two-stage pumps for general water service, cooling towers, drinking water, etc.; Bulletin W-321-B13B, covering steam-turbine driven centrifugal pumps for power plants, air conditioning, refrigeration and heating systems, and industrial plants; Bulletin W-321-B7C, covering Monobloc centrifugal pumps, open impeller type, for use in chemical plants, canneries, sump pumps, breweries and irrigation.

DUST COLLECTING

Peters-Dalton, Inc., 628 East Forest Avenue, Detroit 1, Mich.

Air Processing Equipment is the title of a 56-page catalog showing installations of the company's dust collecting units and systems, spray booths and equipment, ovens and ventilating and engineered air processing systems. Tells the story of the company's engineering facilities, and includes detailed specifications of Hydro-Whirl dust collectors and spray booth units together with engineering data.

FLOW-METERS

Cochrane Corp., 17th & Allegheny Ave., Philadelphia 32.

Reprint No. 29, entitled "Flow Meter Engineering," a 16 page booklet by William C. Bennett, Cochrane Corp., tells why, when, and where flow meters and instruments are needed in the modern plant, and how they can be made to further the war effort. A considerable amount of basic metering data is covered, being arranged in two facing pages for convenient use. Two pages of drawings are devoted to details of proper installation methods. Also includes helpful hints for keeping instruments out of the repair shop.

PLYWOOD

Douglas Fir Plywood Association, Tacoma Building, Tacoma 2, Wash.

A standard size, loose-leaf-punched, 24-page bulletin entitled "Plywood Wartime Uses" and intended as an addition to the "Industrial Uses for Douglas Fir Plywood Handbook."

RECORDING THERMOMETERS

The Bristol Company, Waterbury 91, Conn.

A data sheet has been issued to describe and illustrate recording thermometers that are used in frozen food locker plants.

INDUSTRIAL DEGREE DAYS
April, 1944

City	Number of Industrial Degree Days	
	55F Base	45F Base
Baltimore	120	23
Buffalo	421	159
Chicago	304	88
Cleveland	312	87
Detroit	369	114
Indianapolis	171	55
New York	224	46
Philadelphia	179	31
Pittsburgh	185	54
St. Louis	125	32

COMING EVENTS

JUNE 5-7—The 31st Spring Meeting of The American Society of Refrigerating Engineers, to be held at the William Penn Hotel, Pittsburgh. Secretary, David L. Fiske, 50 W. 40th St., New York, N. Y.

JUNE 7-8—Mid-Year Meeting of the National Warm Air Heating and Air Conditioning Association, to be held at the Stevens Hotel, Chicago. T. Reid Mackin, International Heater Co., is chairman of the Chicago convention committee.

JUNE 19-20—Summer Convention of the American Society of Heating and Ventilating Engineers, to be held at the Pantlind Hotel, Grand Rapids, Mich. Secretary, A. V. Hutchinson, 51 Madison Ave., New York, N. Y.

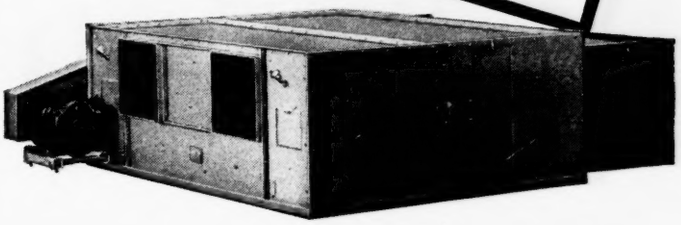
JUNE 20-21. 35th Annual meeting of the National District Heating Association, Hotel William Penn, Pittsburgh, Pa. John F. Collins, Jr., 827 North Euclid Ave., Pittsburgh, Secretary-Treasurer.

NOVEMBER 15-19—Third National Chemical Exposition will be held at the Chicago Coliseum, Chicago, Ill. Sponsored by Chicago Section of the American Chemical Society. Headquarters for the show at 330 So. Wells Street, Chicago 6, Ill.

4-Season AIR CONDITIONING

Available for Essential Needs

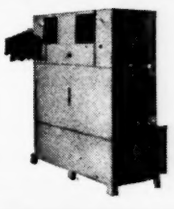
- PRECISION MANUFACTURING
- FOOD PRESERVATION
- HOSPITALS.... LABORATORIES



★ The four seasons are as one where STREAMAIRE Air Conditioning Units are installed. Wide variations in outdoor temperatures and humidity are leveled off into a controlled uniformity that assures ideal research, manufacturing, processing and operating conditions.

Tolerances for precision tools and instruments on many government contracts require that they be manufactured under controlled temperatures and humidity. Priorities for equipment to correct excessive heat and contaminated air conditions harmful to the health of workers can also be obtained. Food processing plants (engaged in canning, dehydrating and freezing perishable foodstuffs), biological laboratories and hospitals may also install YOUNG Air Conditioning Equipment.

If you are not eligible for the cooling and dehumidifying features, you can install a STREAMAIRE Unit with the heating coil now and merely add the cooling coil when restrictions are lifted. Write for Catalog No. 7541.



☆ ☆ ☆ *STREAMAIRE Air Conditioning Units are made in eight horizontal and eight vertical models with capacities ranging from 400 to 16,625 cfm. The large unit above is designed for ceiling suspension. The model at the left is a floor unit.*

YOUNG

BUY BONDS • PRODUCE MORE • SALVAGE SCRAP • WIN THE WAR

HEAT TRANSFER ENGINEERS

Manufacturers of Oil Coolers • Gas, Gasoline, Diesel Engine Cooling Radiators • Intercoolers • Heat Exchangers • Engine Jacket Water Coolers • Unit Heaters • Convectors • Condensers • Evaporators • Air Conditioning Units • Heating Coils • Cooling Coils • and a Line of Aircraft Heat Transfer Equipment.

YOUNG RADIATOR CO., Dept. 104-F, RACINE, WIS.

APPLICATION ENGINEERS in Principal Cities